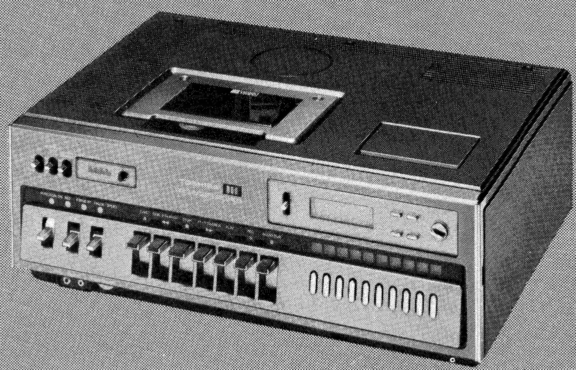
SERVICE DATA
FILE NO.030-018

TOSHIBA

COLOUR VIDEO CASSETTE RECORDER

V-5470



SPECIFICATIONS

General

Video recording system:	Rotary two-head helical scanning
Video signal:	CCIR standards, PAL colour
Storage temperature:	–20°C to +60°C (–4°F to +140°F)
Aerial:	75-ohms external aerial terminal for VHF and UHF
Channel coverage:	CCIR B.G. system VHF channels E2-E12 UHF channels E21-E68 (a total of up to 10 preselected channels)
AERIAL output signal:	UHF channels E31 to E39 (variable) 75-ohms unbalanced
Power requirements:	220V AC 50 Hz
Power consumption:	44W
Weight:	14kg (30.9 lbs.)
Dimensions:	475 x 178 x 386mm (W/H/D) (18.7 x 7.01 x 15.2 inches) (W/H/D)

Video

Input:	VIDEO LINE IN: Phono-type connector $1.0V\ (p\text{-}p)\ {}^{+1.0V\ (p\text{-}p)}_{-0.5}$ 75-ohms unbalanced, sync. negative
Output:	VIDEO LINE OUT: Phono-type connector 1.0V (p-p) ± 0.1V (p-p), 75-ohms unbalanced, sync. negative
Signal to noise ratio:	Better than 42dB

Audio

Input:	AUDIO LINE IN: mini-jack, 68k-ohms, –10 dB MIC: mini-jack, –70 dB suitable for microphone with more than 680-ohms impedance
Output:	AUDIO LINE OUT: mini-jack, less than 10k-ohms, –5dB, unbalanced (load: more than 50k-ohms)
Frequency response:	50 Hz to 8,000 Hz
Signal to noise ratio:	Better than 40dB
Audio distortion:	Less than 4% at 400 Hz

Tape transport

Tape speed:	18.73mm/sec.
Maximum recording time:	2 hours 10 min. (with L-500 cassette) 3 hours 15 min. (with L-750)
Fast forward time:	Within 3.5 min. (L-500)
Rewind time:	Within 3.5 min. (L-500)

TIMER

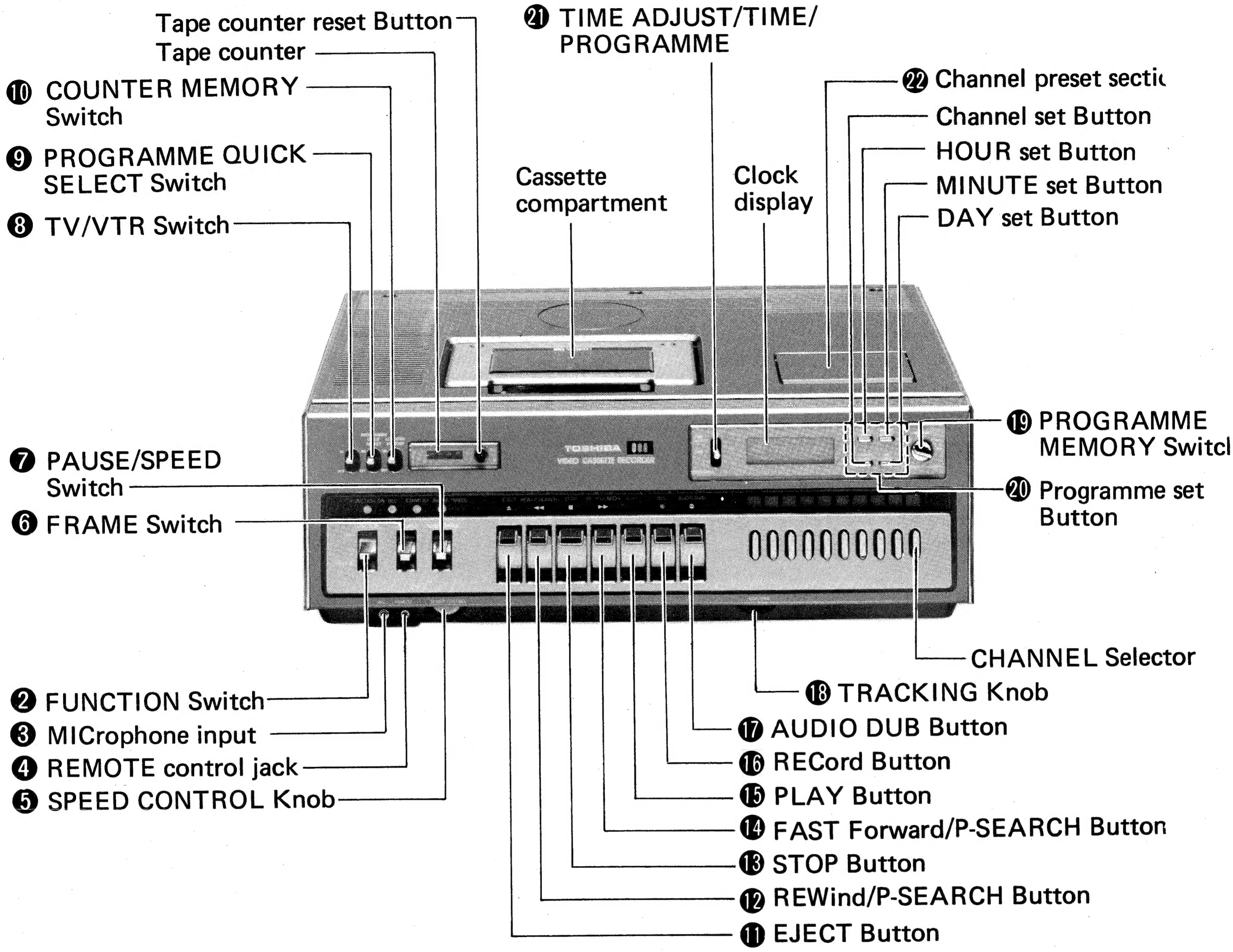
LCD digital display
Count down from Quartz oscillation

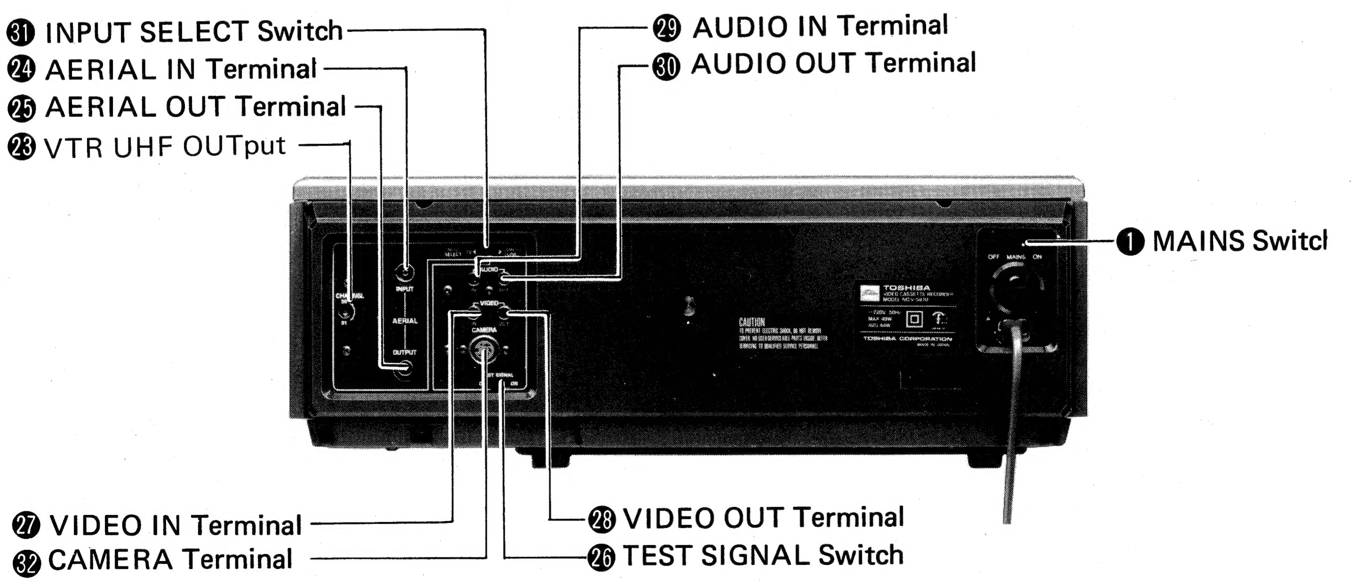
Desing and specifications are subject to change without notice.

Caution: The unauthorized recording of television programmes and other materials may infringe on the rights of others.

SECTION 1 GENERAL

GENERAL





❶ MAINS Switch
Turn this switch on at the rear of the VTR. The STAND-BY lamp and clock indication will come ON. Turn this switch off before going out to conserve energy and for safety.
NOTE: If MAINS Switch is turned off, the clock and channel memory are lost.

❷ FUNCTION Switch
Set to ON position to make the VTR ready for operation. The STAND-BY lamp goes OFF and FUNCTION lamp will come ON. For time, operation, set this switch to TIMER position. When the unit is not in use return the switch to STAND-BY.

❸ MIC (microphone) input terminal
This terminal is provided to connect a microphone. When a microphone is connected to this terminal, the audio signal from the microphone is always recorded. Use this jack for audio dubbing and recording with a camera when the built in camera mic is ineffective.

❹ REMOTE CONTROL JACK
When the remote control unit is connected to this JACK. It is possible to control the various functions (EX; PAUSE, STILL, SLOW and FRAME by FRAME) from the comfort of your armchair. The Various controls can be operated by the push of a button on the remote control unit.

❺ SPEED CONTROL Knob
You can shift the picture from still to double speed during the playback mode by controlling this knob. (THE PAUSE/SPEED switch must be depressed before.) Some noise may appear on the Picture but it is a normal condition.

❻ FRAME Switch
When the FRAME Switch is depressed in the still mode of speed control during the playback operation, the frozen picture advances one frame.
The frozen picture advances frame by frame automatically when this Switch is kept depressed.

❼ PAUSE/SPEED Switch
When recording a tape, you can stop the operation temporary by depressing this switch. When playing-back pre-recorded tape, you can obtain any playing-back condition from still mode to double speed of picture movement as well as normal movement by depressing this switch and adjusting the SPEED control knob. Within about 3 minutes of depressing this switch, above mode will be released automatically to protect the tape from possible damage, but you can release it manually by depressing this switch or STOP button.

❽ TV/VTR Switch
The TV/VTR Switch should be placed into the TV position while viewing an off-air TV programme.
But this Switch should be placed into the VTR position when viewing the TV programme from the built-in tuner.
When the PLAY Button is depressed, the recorded programme is played back via RF unit onto the TV receiver in any position of this Switch.

❾ PQS (Programme Quick Select) Switch
This switch is very convenient for locating the start position of a programme in a Video Cassette, tape that containes several programmes. If the tape is on the Fast Forward or Rewind mode while this switch is positioned at ON, the tape movement automatically stops between programmes. However this switch does not work during picture search operation.

❿ COUNTER MEMORY Switch
This switch is used to locate a particular point from which the viewer wishes to operate the playback mode.
With the Counter Memory switch ON, the tape stops automatically during rewind when the counter reaches 9999.

⓫ EJECT Button
Used to open the cassette compartment. The cassette compartment will come up about 4 seconds after this button is depressed and you can take the video cassette out.

⓬ REW (rewind)/P-SEARCH Button
If you depress this button during the playback mode, you can search the programme with the picture in reverse some noise may appear on the picture, but this is normal.

⓭ STOP Button
Depress to stop.

⓮ FF (fast forward)/P-SEARCH Button
If you depress this button during the playback mode, you can search the programmes with picture moving. Some noise may appear on the picture but this is normal.

⓯ PLAY (playback) Button
Depress for reproducing pre-recorded tape.

⓰ RECord Button
Depress for recording. (This button cannot be depressed when the safety tab has been removed from the video cassette. This can save you from destroying valuable pre-recorded tapes.)

⓱ AUDIO DUB (dubbing) Button
Allows you to record your own sound on previously recorded cassette using either your microphone or audio system. The previously recorded sound will be completely erased. (This audio dub button also cannot be depressed if the safety tab is removed.)

⓲ TRACKING Knob
Controls for minimizing noises appearing in horizontal picture lines in the playback mode of operation. To be set in the center position when recording.

⓳ PROGRAMME MEMORY Switch
This switch sets the three programmes of the ON and OFF positions of the Programme Timer with the TIME ADJUST/TIME/PROGRAMME Switch (21) and the Programme Set Button (20).

⑳ Programme set Button
These four buttons are used to set the timer function of the VTR so different programmes can be recorded as you want to record them.

* HOUR set Button
  Push the HOUR button and the time is advanced by one hour.
  Hours are advanced rapidly when this button is pressed for more than one second.
* MINUTE set Button
  Push the MINUTE button and the time advances by one minute.
  Minutes are counted up rapidly when this button is pressed for more than one second.
* CHANNEL set Button
  This is a Channel Selector button used when recording with the Programme Timer.
* DAY set Button
  This button sets the programme recording day to the current date.

㉑ TIME ADJUST/TIME/PROGRAMME Switch
Used for adjusting to present time and setting timer.

㉒ Channel preset section
The Channel preset section is used to select and set the broadcasting channels in the Microcomputer memory channels. Refer to the description of Microcomputer Channel Adjustment for further details.

㉓ VTR UHF OUTput
UHF output channel of RF unit is adjustable in your area among the channel E31-39 on the TV.

㉔ AERIAL IN terminal
Connect the antenna line from a AERIAL (VHF/UHF) to this terminal for recording of TV programmes.

㉕ AERIAL OUT terminal
Used when VTR recorded tapes are played back on a TV set screen. Interconnect this AERIAL output terminal and the AERIAL IN terminal of the TV set by the supplied coaxial cable.
This terminal is related to the TV/VTR switch at the front panel. Set the TV/VTR switch to TV when you want to watch a television programme with VTR powered. During the playback mode, switch will be automatically selected to VTR position by means of an electric switch.

㉖ TEST SIGNAL Switch
Once the TV receiver is adjusted for use with the VTR and channels are pre-set on the VTR, you can view and/or record the programmes selected by depressing one of the channel select buttons on the VTR. Moreover, you can record a selected programme on the VTR while viewing a different selection on the VTR.
First the TV must be adjusted to accept the VTR out-put channel from the RF unit that is contained in the compartment at the rear of the VTR.
Proceed as follows:

1. Perform the connections and set the MAINS Switch to ON.
2. Set both the FUNCTION Switch and the TEST signal switch at the rear of the VTR to ON, and the TV/VTR switch to VTR.
3. Turn on the TV.
4. Adjust one of the TV's unused channel selectors in the range of the RF unit out-put channel between UHF *31-39 until a black and white pattern is clearly displayed on the TV screen.

㉗ VIDEO IN Terminal
Used for connecting a TV camera or other video equipment. When using this terminal, set the INPUT SELECT switch (31) to LINE side.

㉘ VIDEO OUT (video signal output) Terminal
A video signal during both recording and playback can always be obtained from this terminal. You can feed the video signal of this terminal to other video equipment.

㉙ AUDIO IN (audio signal input) Terminal
An audio signal during both recording and playback can always be otained from this terminal. The audio signal of this terminal can be fed to audio equipment.

㉚ AUDIO OUT Terminal
An audio signal is available both during recording and playback for use by other equipment.

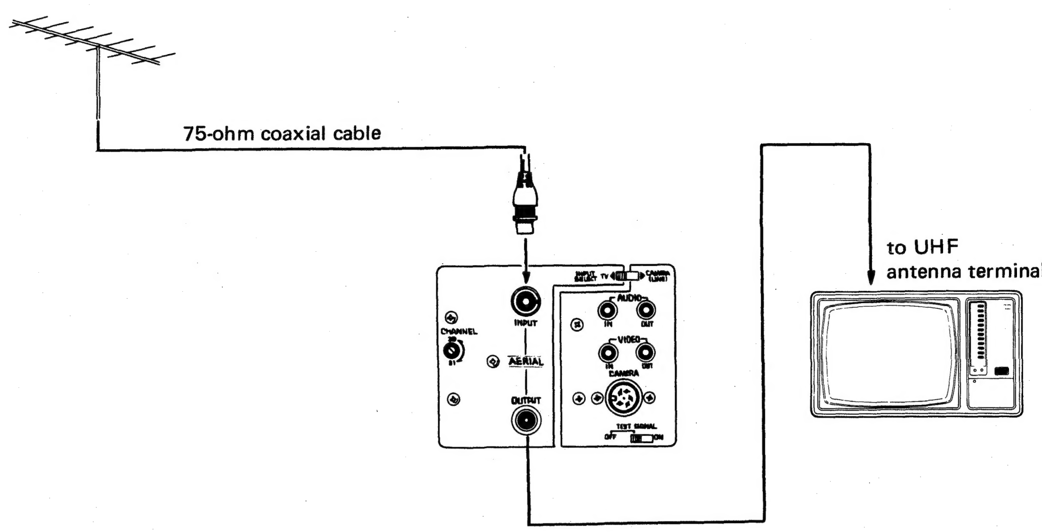
㉛ INPUT SELECT Switch
Set the switch to the TV position when recording a TV programme using the VTR tuner. Set to LINE position when using a TV camera which is connected to MIC or AUDIO IN and VIDEO IN. It is also possible to connect your camera to CAMERA (DIN) input instead of connecting VIDEO IN and MIC input.

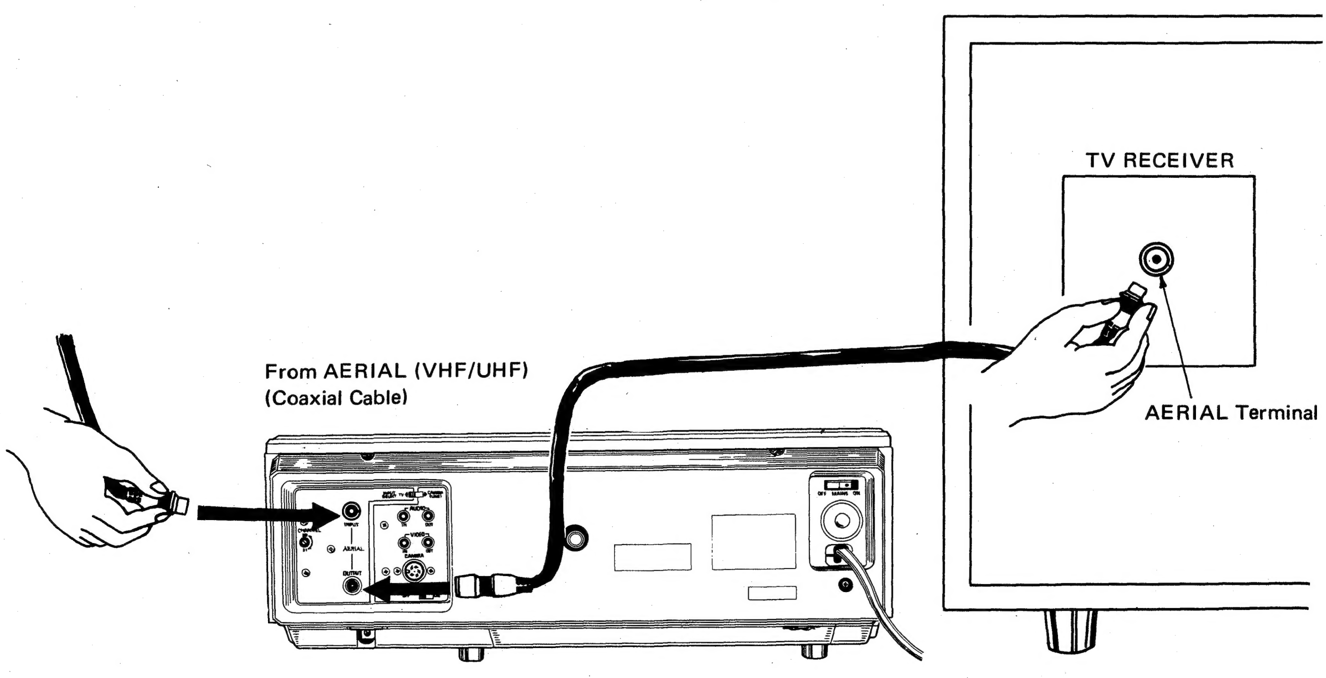
㉜ CAMERA Terminal
Use this DIN connector for single cable connection of the video, audio and remote start/stop signal. The potional black/white and color cameras are equipped with DIN connector, located on the rear.
Note: Do not connect VIDEO IN and CAMERA IN (32) (6-pin camera input) at the same time. Do not attempt to connect two cameras or other video equipment at the same time into this terminal and the VIDEO IN terminal as video signal mixing can not be done by this method and the cameras may be damaged.

CONNECTION

AERIAL TV Cable Connection

Connect a 75 ohm coaxial cable from a AERIAL (VHF/UHF) to AERIAL IN terminal at rear of the VTR.
Connect between AERIAL OUT terminal of VTR and AERIAL terminal of TV receiver with a 75 ohm coaxial cable.
(Please keep the input select switch to the TV position.)





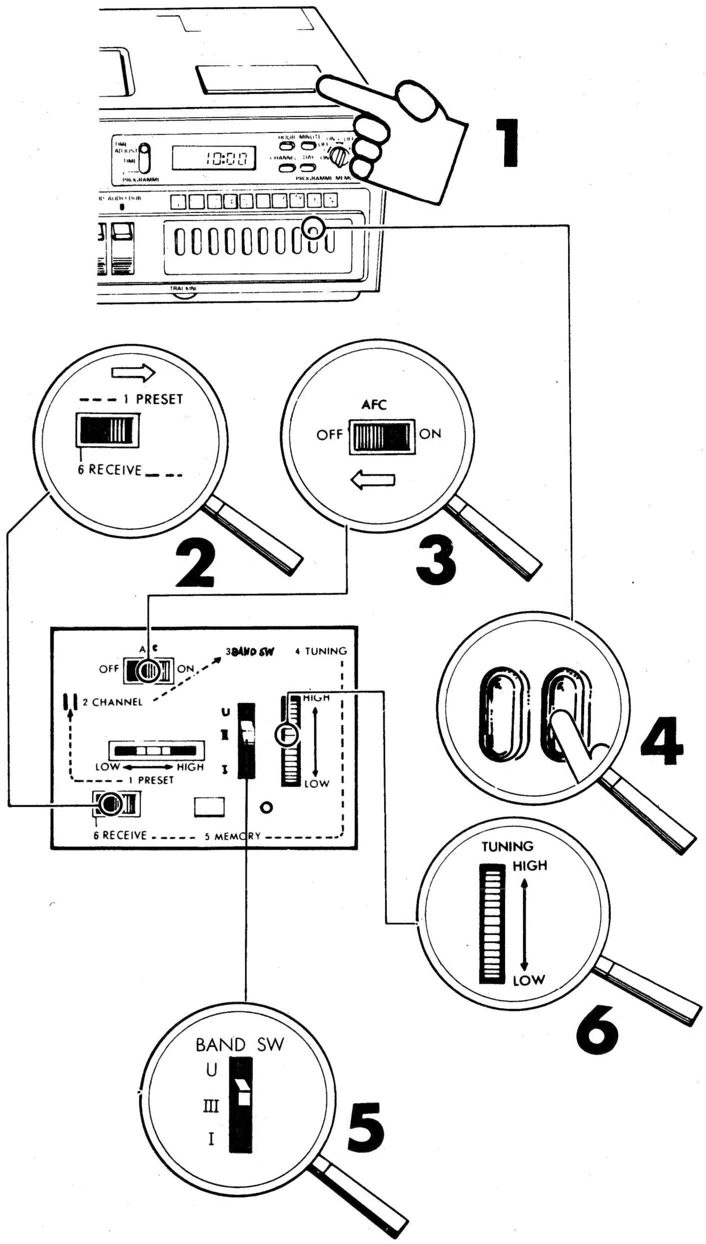
CHANNEL SETTING

The Channel Selectors are pre-adjusted at the factory to a range of common channels, but these might not suit your requirements or your local programme channels. However, before changing the channel arrangement, touch each of the selector buttons in turn to see which channels are correctly tuned. As you do this the programmes will appear on your television screen and final adjustment of your receiver can be done for correct colour, etc.

If you wish to change the channel arrangement, proceed as follows:

1. Open the tuning control cover which is located in the right-hand corner of the top of the recorder.
2. Set the PRESET/RECEIVE switch to PRESET.
3. Set the AFC switch to OFF to disable the Automatic Frequency Control.
4. Touch the channel selector button you wish to tune. The light above the button will show that it has been selected.
5. If you are tuning in channels 2, 3 or 4, set the CHANNEL BAND switch to the I position. If you are tuning in channels 5, 6, 7, 8, 9, 10, 11, or 12, set the CHANNEL BAND switch to the III position. If you are tuning in channels 21 through 68, set the CHANNEL BAND switch to the U position.

I: Lower VHF band	(cahnnels 2– 4)
III: Higher VHF band	(channels 5–12)
U: UHF band	(channels 21–68)



6. Tune the programme you require by turning the TUNING control until a good quality picture is received.

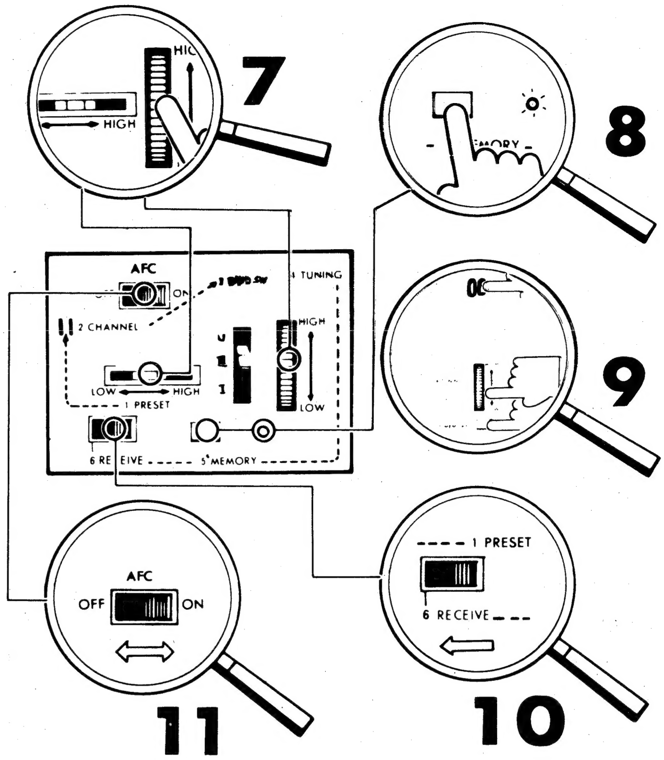
7. The red indicator to the side of the control shows the approximate channel number, and if it is at the end of the scale the control will click as it is turned. If this occurs, turn the control in the opposite direction.

8. When the programme is correctly tuned, press the MEMORY button to store the tuning information in the tuning memory. The red MEMORY indicator must go out as you press the button. If this does not happen, the memory has failed to function and you should try again.

9. Repeat steps 4 to 8 for any other channel selector you wish to use.

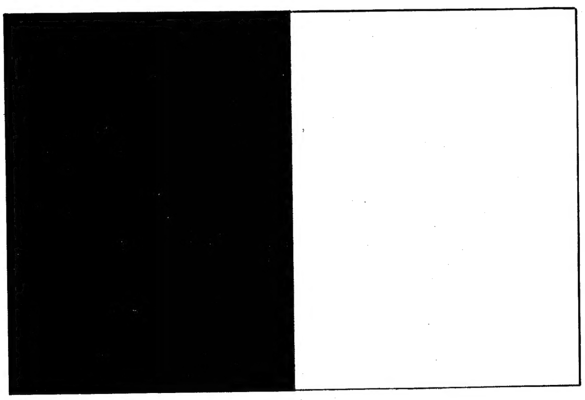
10. After you have tuned all the channel selectors, make sure that you set the PRESET/RECEIVE switch to the RECEIVE position.

11. Reset the AFC switch to the ON position to ensure continued accurate tuning.



Channel Indicator Label
The Channel Indicator Label can be pulled-out from the side of the recorder and the indicators re-arranged to suit you own requirements.

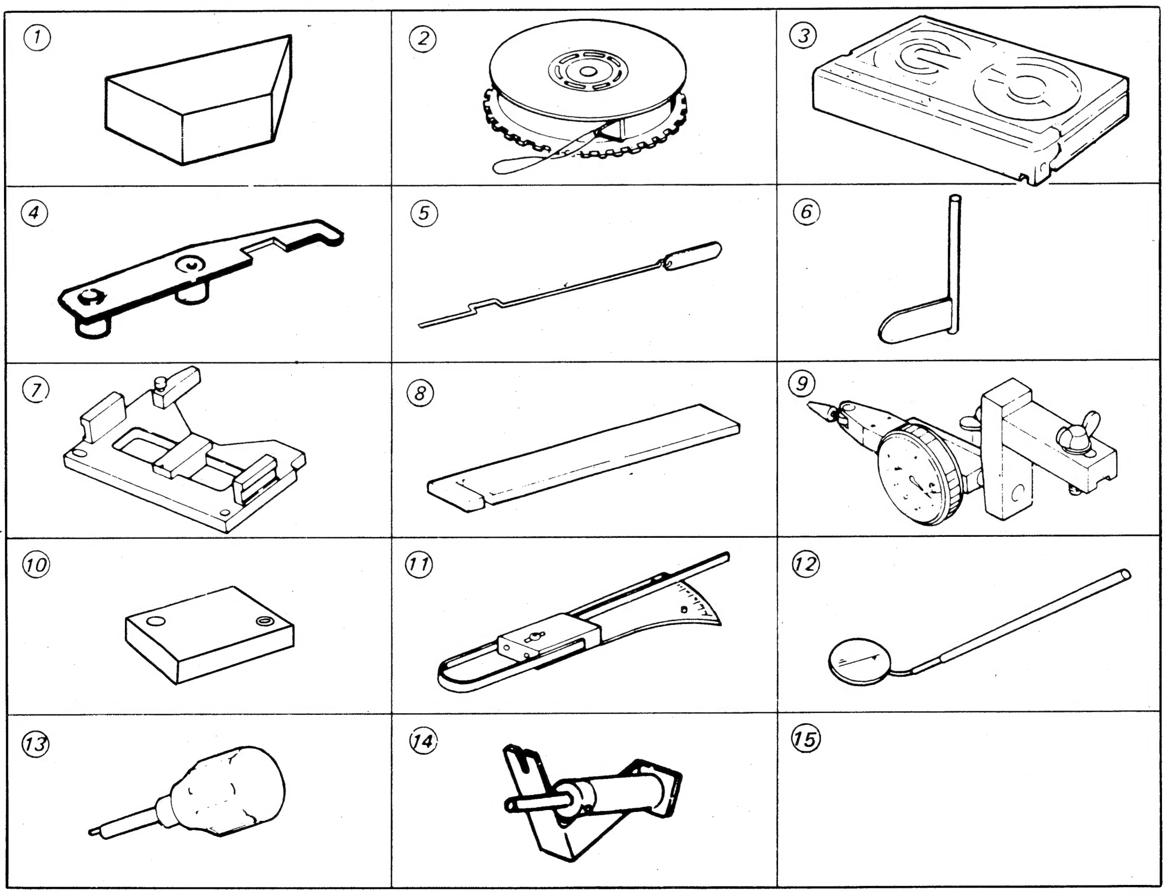
TV ADJUSTMENT and CHANNEL PRE-SETTING
Adjust one of the TV's unused channel selectors in the range of the RF unit output channel between UHF E31-39 until a black and white pattern is clearly displayed on the TV screen after setting the TEST SIGNAL Switch to ON.



TOOL AND JIGS REQUIRED

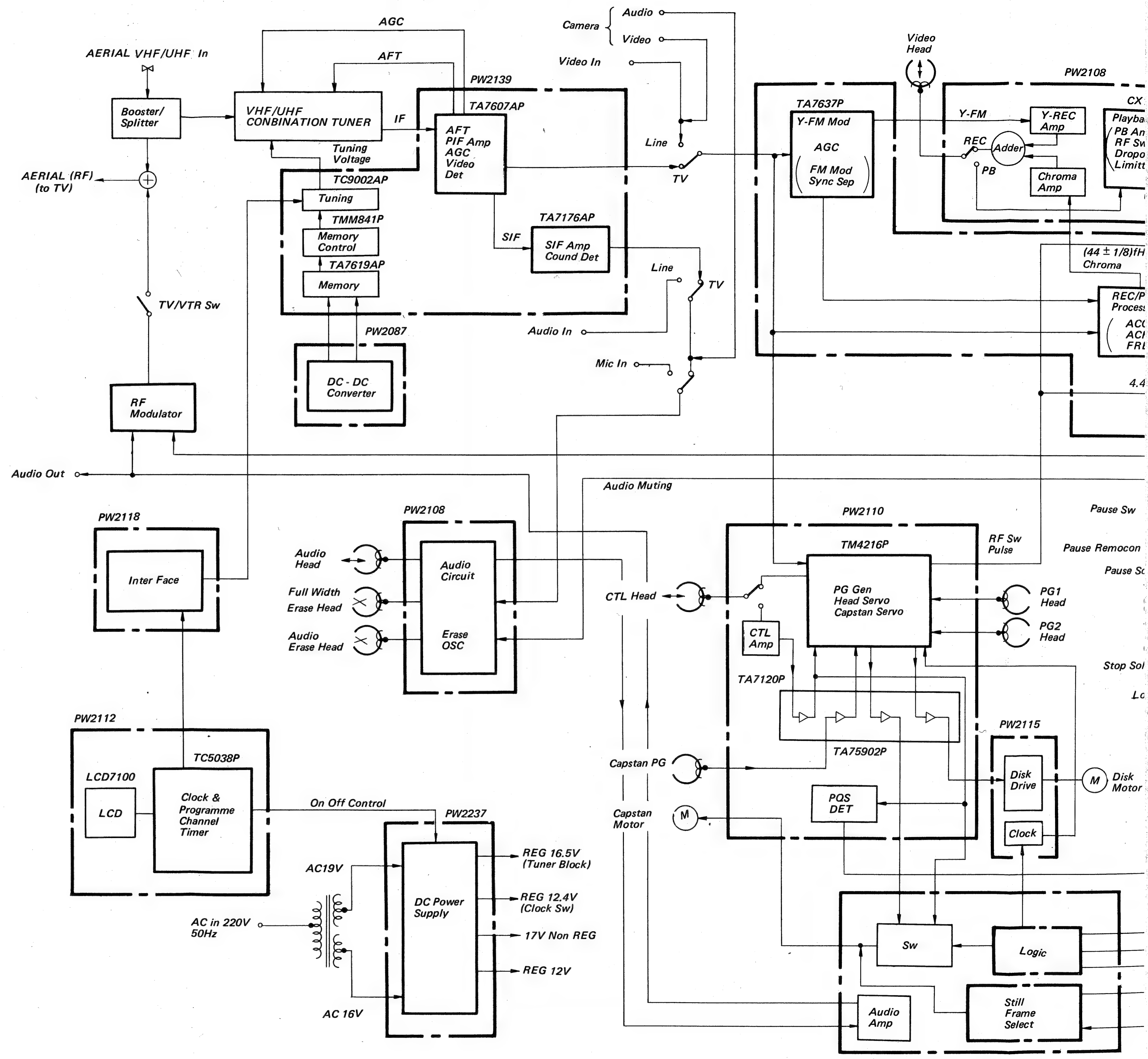
NAME	CODE NO.	JIG NO.	QTY	SKETCH NO.	REMARK
Tape Guide Adjustment Jig	70909036		1	1	○
Forward Back-Tension Measurement Jig Fixture	70909025	SL-0002	1	2	○
T type Torque Measurement Cassette	70909031	SL-0003	1	3	x
R-F type Torque Measurement Cassette	70909030	SL-0004	1	3	x
Tension Regulator Forward Position Jig Fixture	70909037		1	4	○
DC Motor Gear Spacer	70909017	SL-0006	1	5	○
Loading Ring Clearance Gauge	70909018	SL-0007	1	6	○
Cassette Reference Plate	70909019	SL-0008	1	7	○
Tension Regulator Bending Jig Fixture	70909020	SL-0009	2	8	○
Rotating Head Disc Alignment Jig Fixture (Eccentricity Gauge)	70909021	SL-0012	1	9	○
Jig plate (Eccentricity Gauge)	70908007	SL-0013	1	10	○
Tension Gauge (Max. 100g)	70909024		1	11	○
Tension Gauge (Max. 200g)	70909012		1	11	x
Tension Gauge (Max. 500g)	70909029		1	11	○
Inspection Mirror	70954001		1	12	○
Eccentric Screwdriver	70909023	SL-0016	1	13	○
Alignment Tape (KR5-1C)	70909032		1		○
Forward Tension Alignment Jig	70909005		1	14	○
Oil Injection Kit	70956001		1		○

Note: ○ . . . Indispensable tool x . . . Not indispensable tool



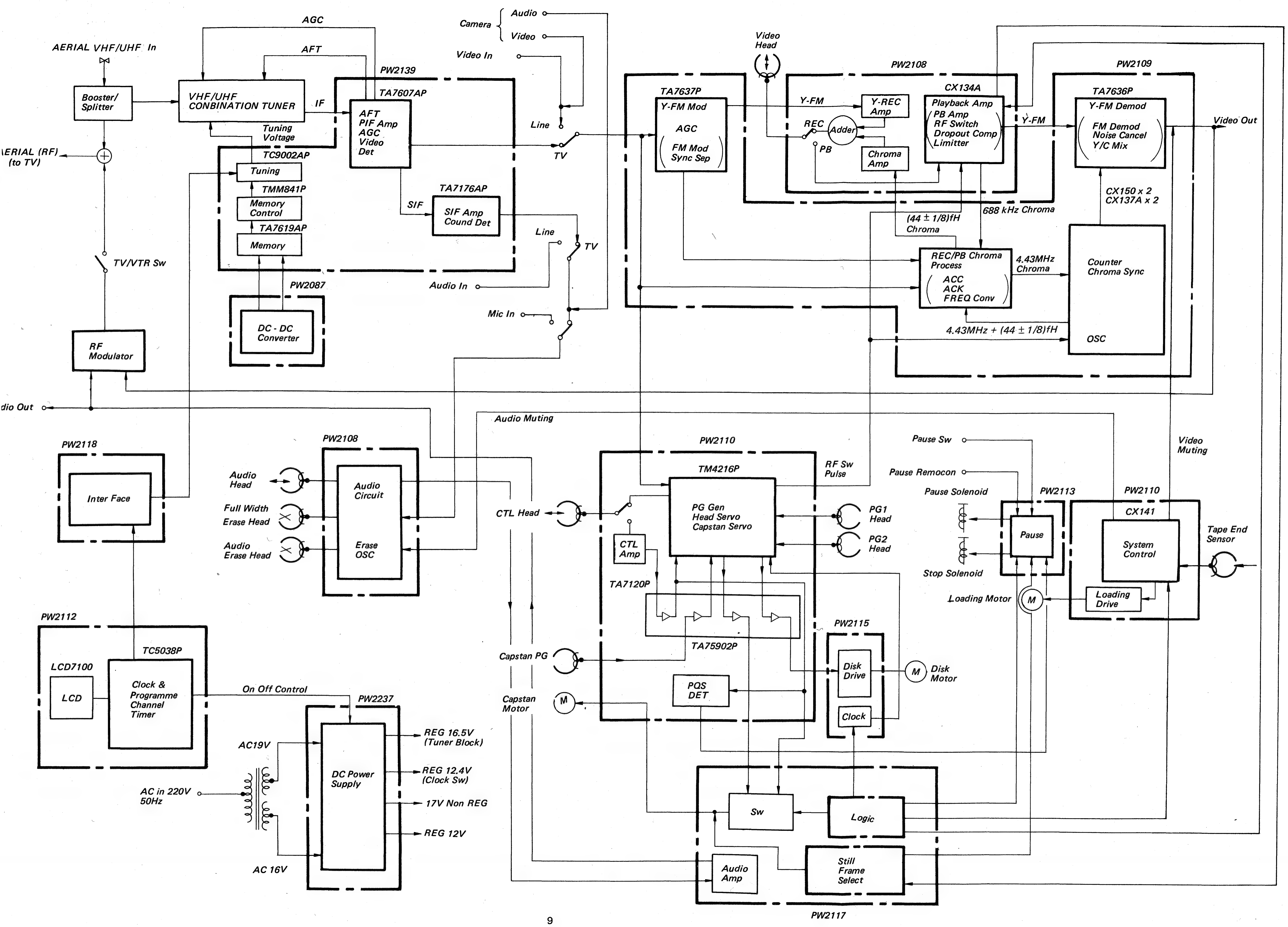
SECTION 2 BLOCK DIAGRAM

2-1 OVERALL BLOCK DIAGRAM

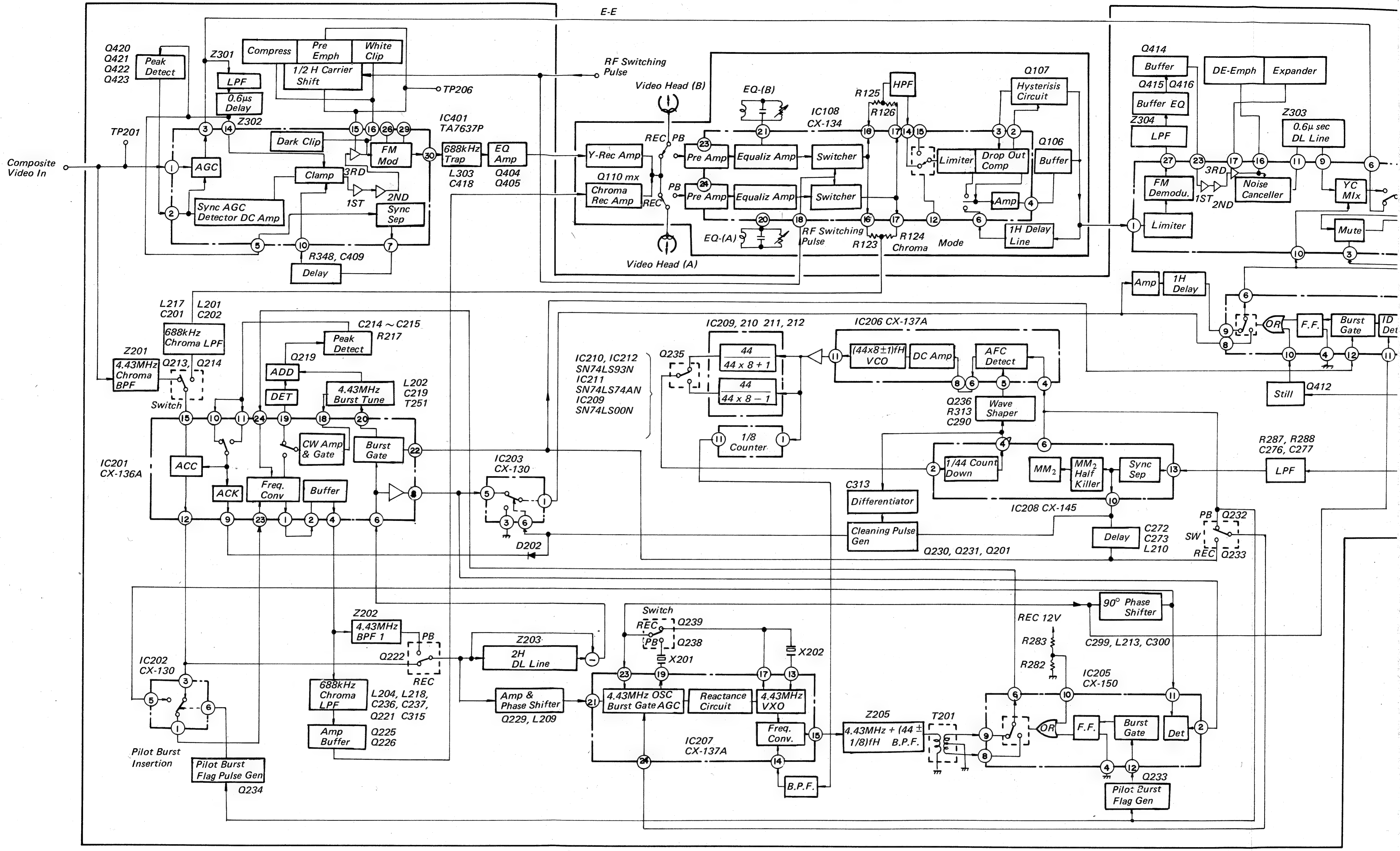


SECTION 2 BLOCK DIAGRAM

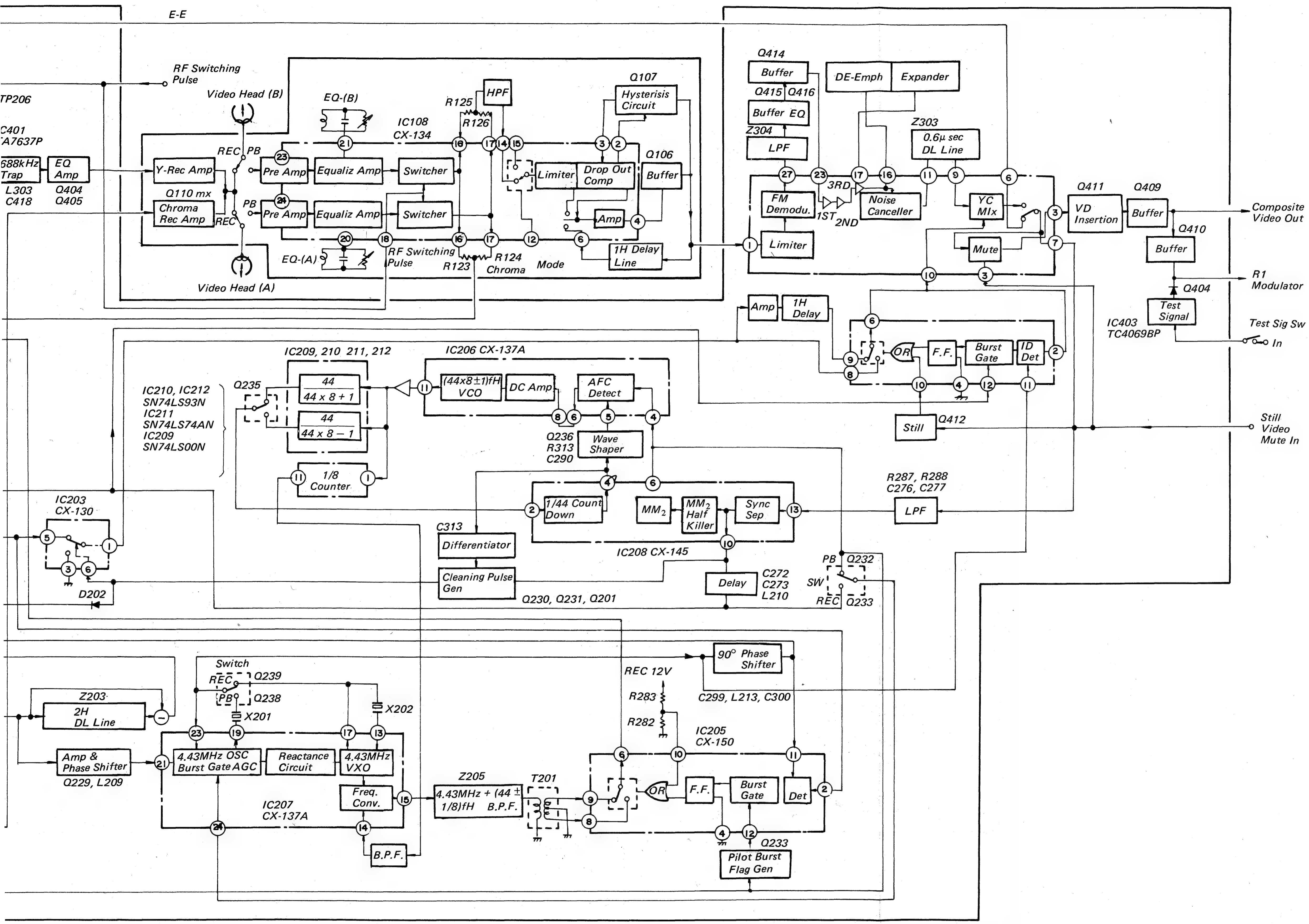
2-1 OVERALL BLOCK DIAGRAM



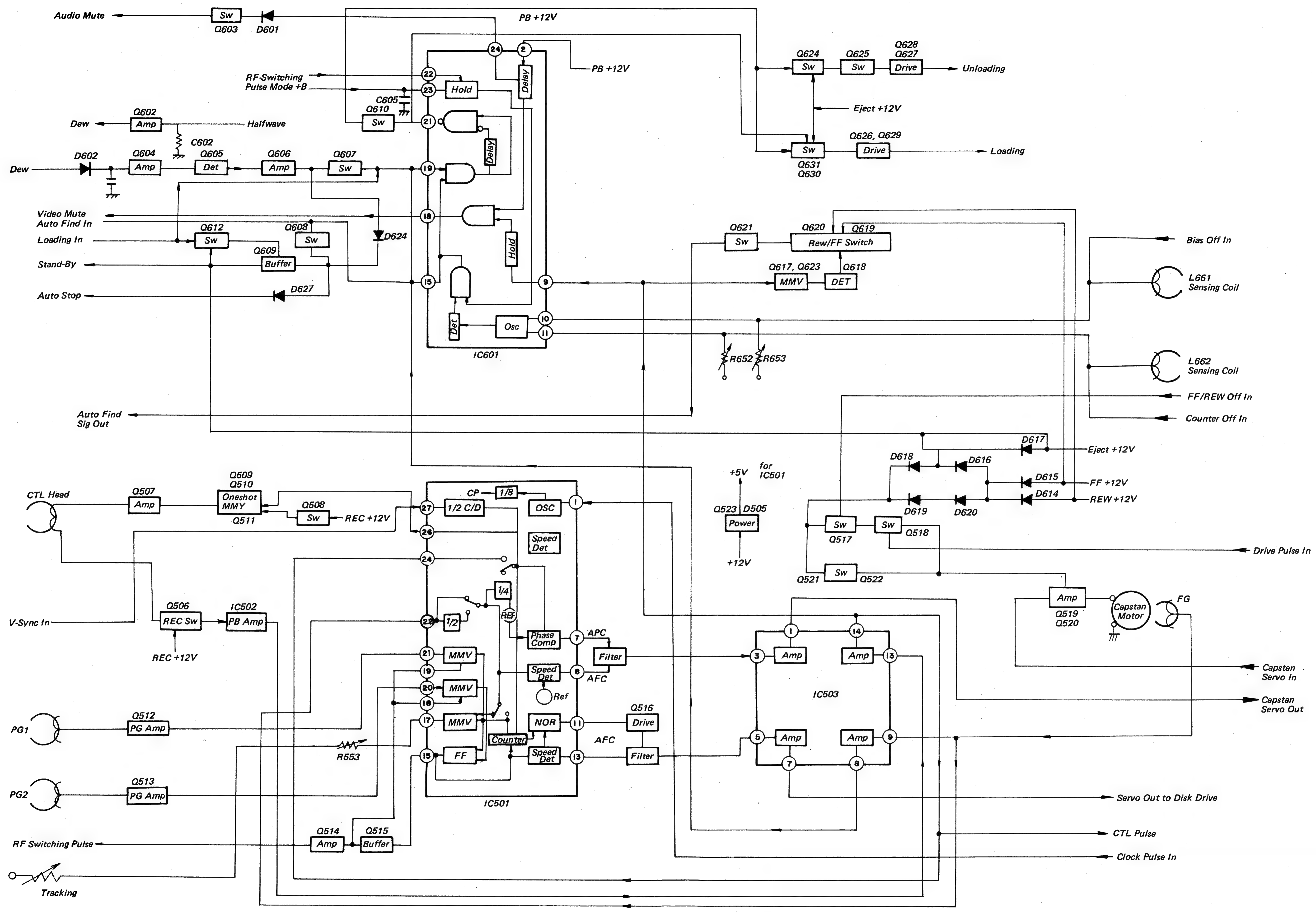
Video System Block Diagram



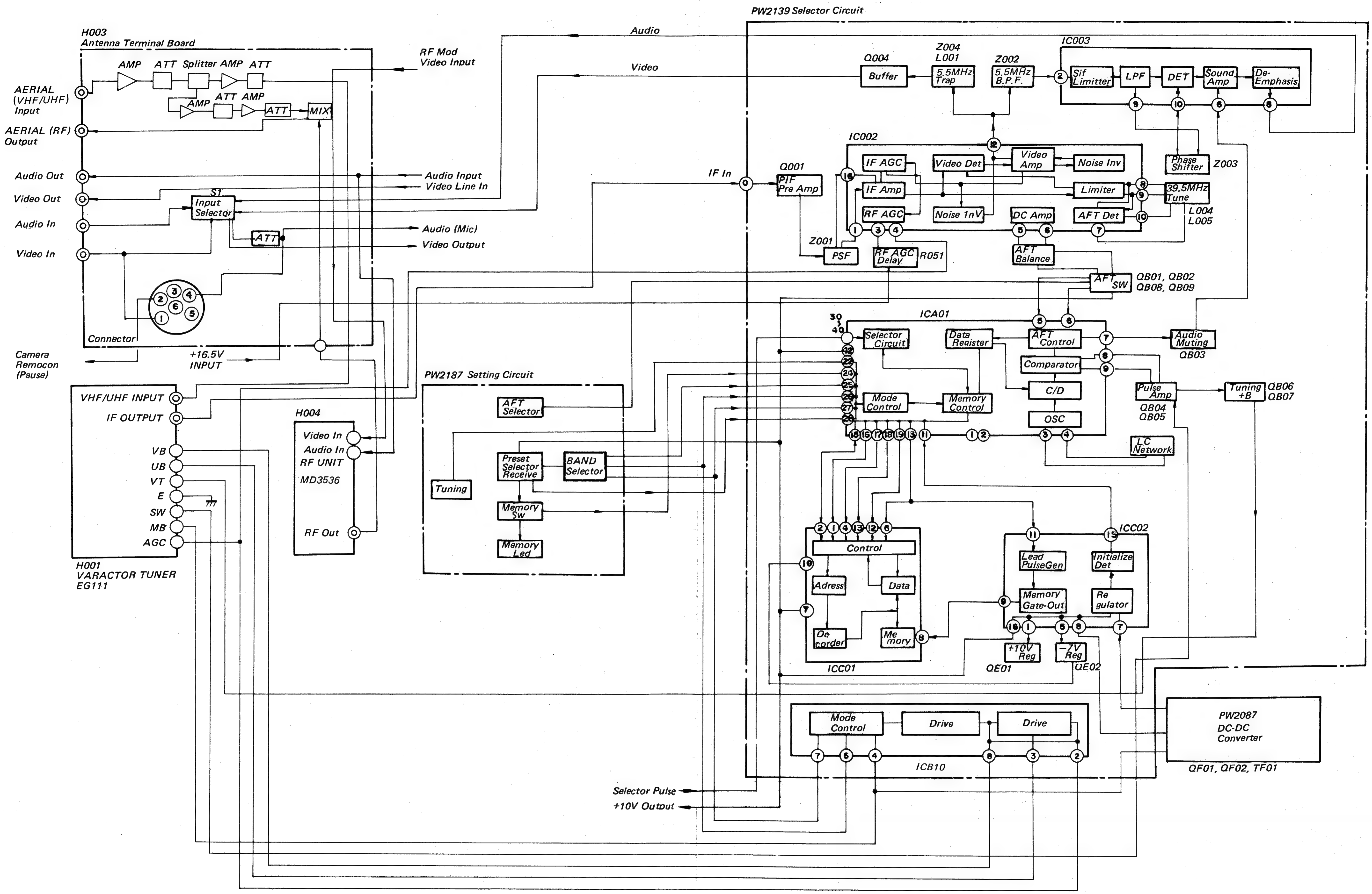
2-2 VIDEO SYSTEM BLOCK DIAGRAM



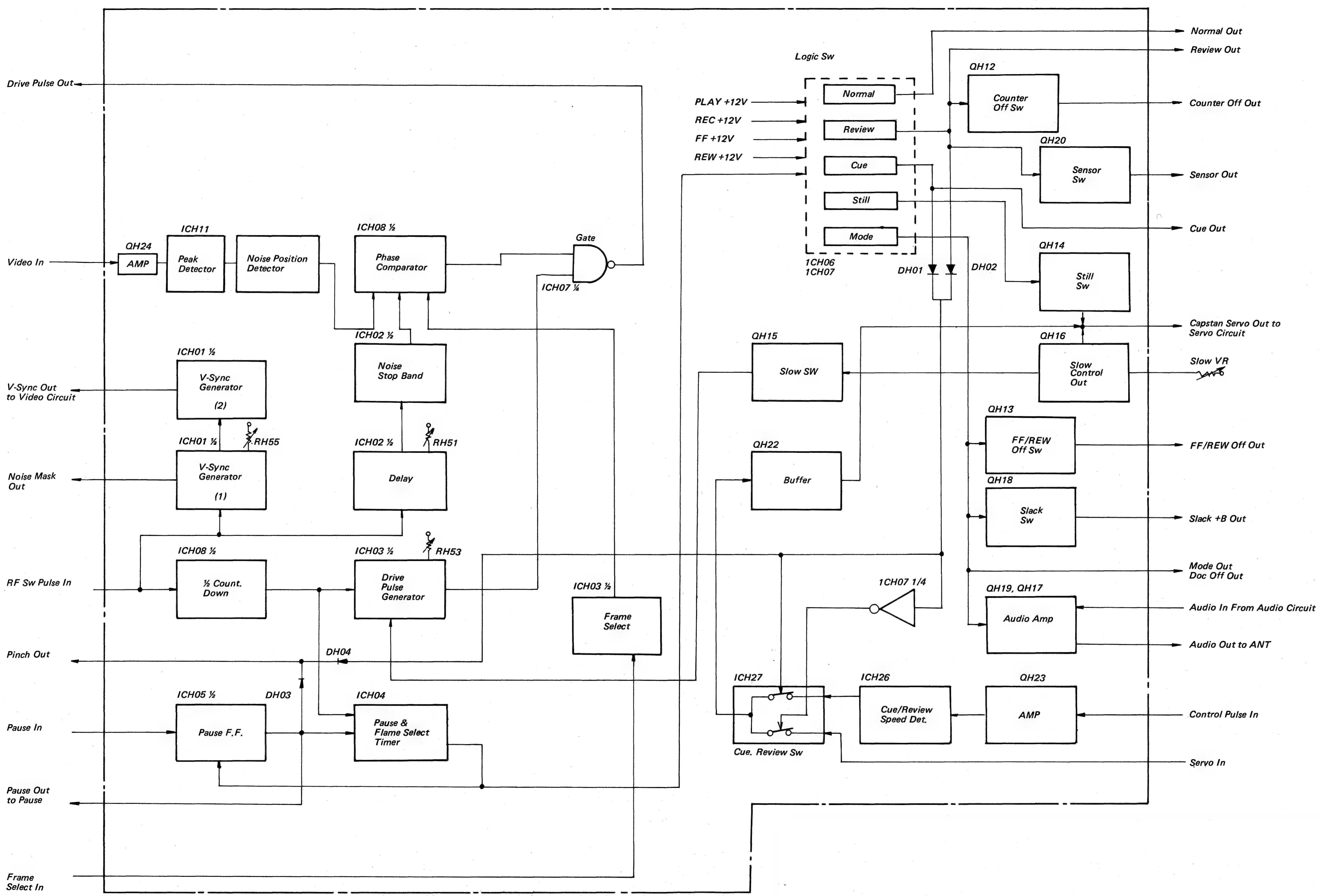
2-3 SERVO AND LOGIC BLOCK DIAGRAM



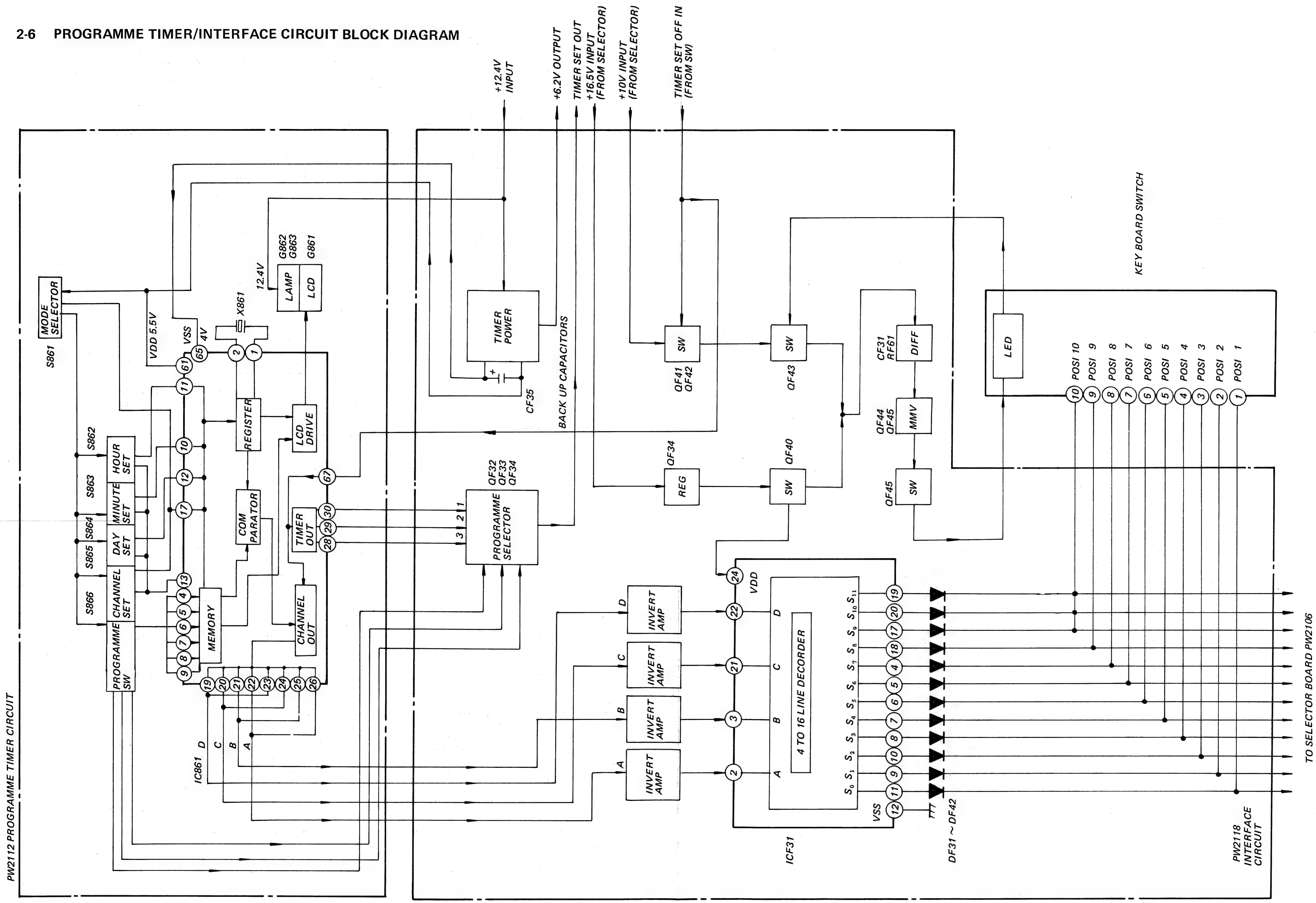
2-4 SELECTOR BLOCK DIAGRAM



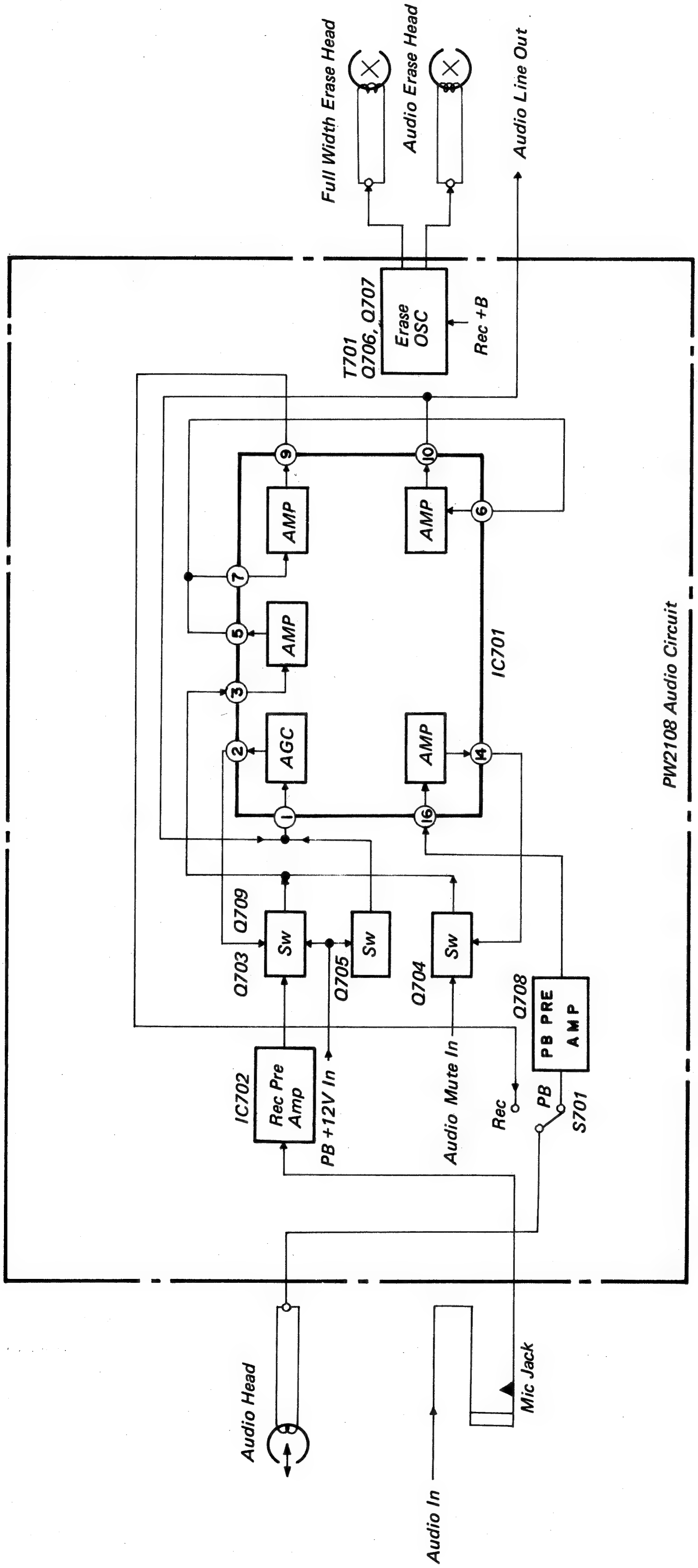
2-5 SPEED CONTROL LOGIC CIRCUIT BLOCK DIAGRAM



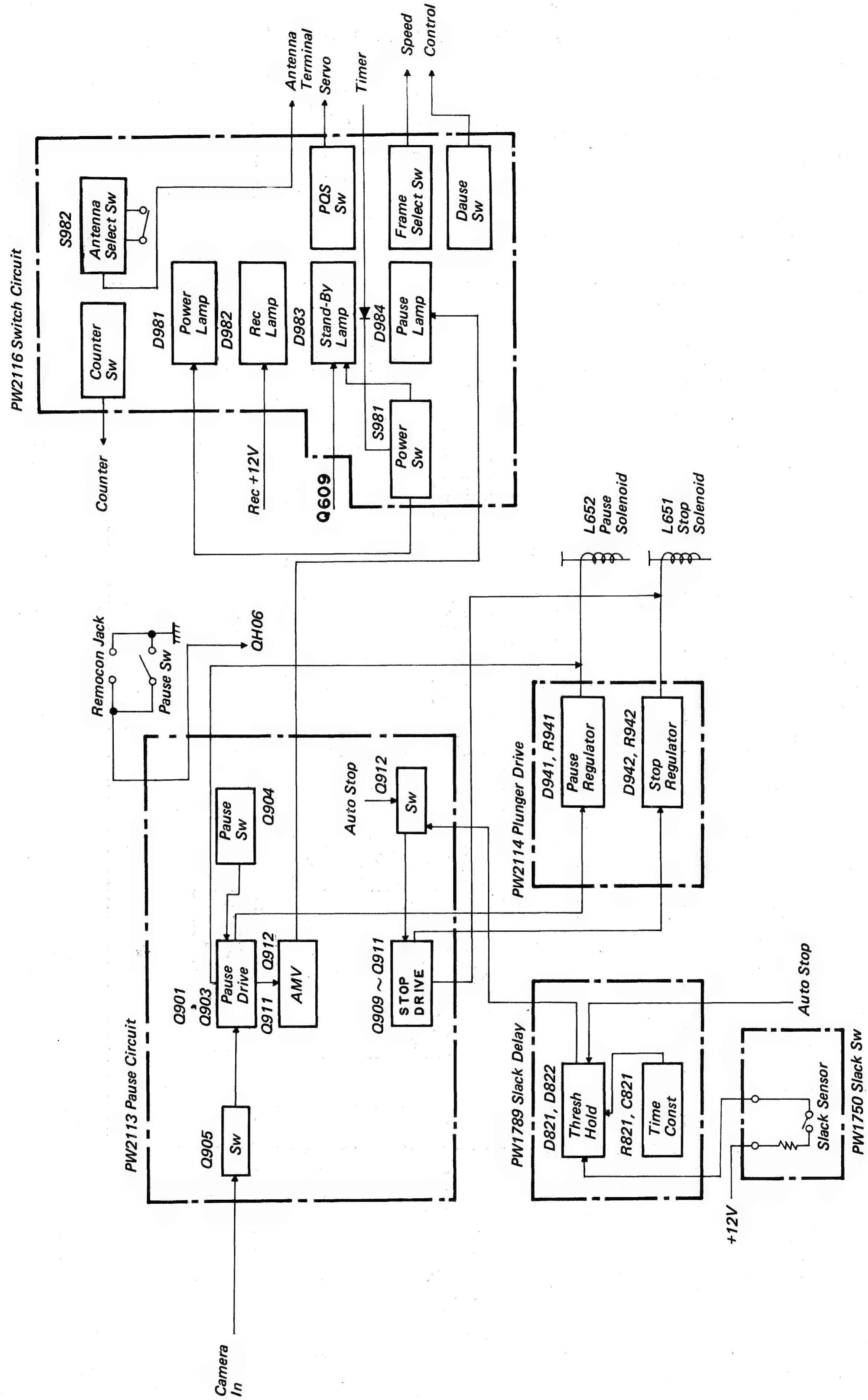
2-6 PROGRAMME TIMER/INTERFACE CIRCUIT BLOCK DIAGRAM



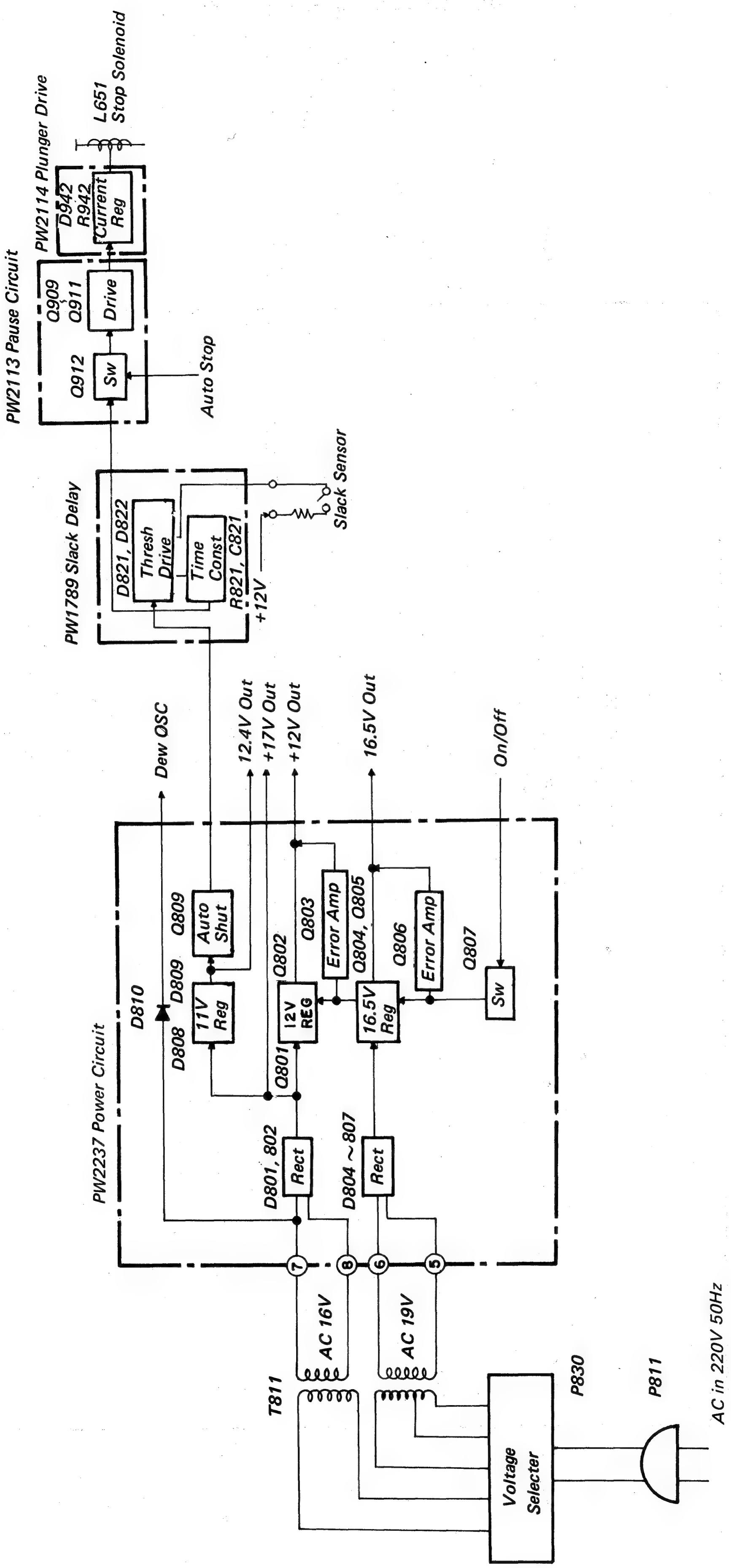
2-7 AUDIO BLOCK DIAGRAM



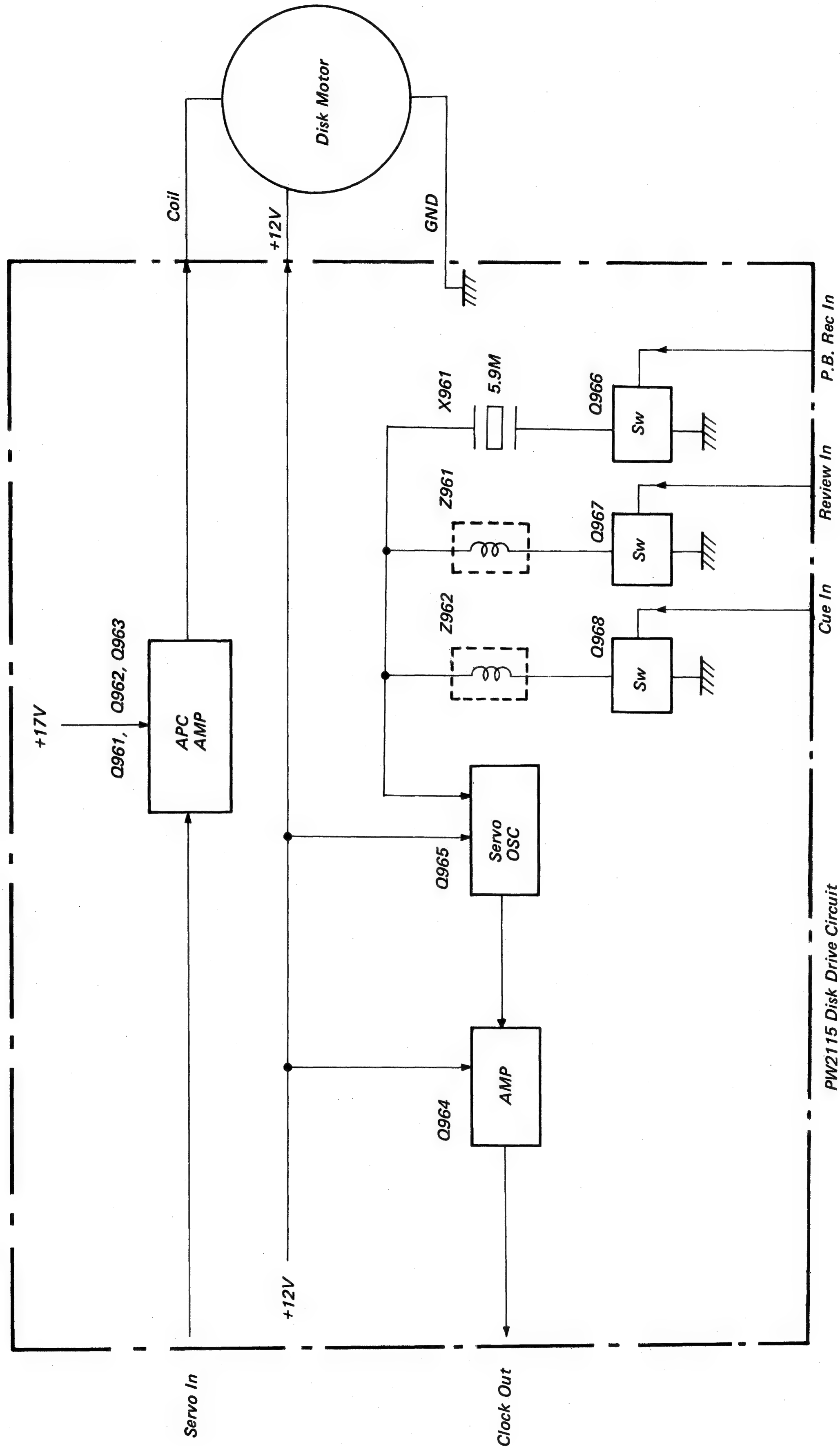
2-8 SOLENOID DRIVE BLOCK DIAGRAM



2-9 POWER BLOCK DIAGRAM



2-10 DISK DRIVE BLOCK DIAGRAM



SECTION 3 ELECTRICAL DESCRIPTION

3-1. BETAFORMAT RECORDING SYSTEM

3-1-1. General

A high density recording is performed in this machine for reducing the sizes, weights, and prices of the VTR itself and the cassette as a domestic VTR. The following recording system is adopted for the high density recording.

1. **Overlap Recording**
   An overlap recording for which the guard band between the video tracks is reduced to zero is performed. (See Fig. 3-2.) In this case the crosstalk from the adjacent tracks causes trouble. The crosstalk in the luminance signal is removed by providing $\pm 7^\circ$ azimuth between the two video heads in order to utilize the azimuth loss in high frequencies.
   The luminance signal is shifted by 1/2 fH to offset the crosstalk. (See Fig. 3-1.) The crosstalk in the chroma signal is removed by a new colour recording system because its frequency is rather low and the azimuth loss is not so large.
2. **Short Wave Length Recording**
   Since the diameter of the head drum is 74.5 mm, the relative speed of the video head and the tape is 5.8 m/sec and the highest recording wave length (frequency which can be recorded) becomes short, 0.7 μm. The gap width of the video head is narrowed to 0.4 μm to realize the short wave length recording and the playback sensitivity in the short wave length is improved with the tape magnetic material (CrO_2, $Co\text{-}Fe_3O_4$).
3. **Narrow Track Recording**
   The track width of the video head is narrowed for reducing a tape consumption and the narrow track recording with a track pitch of 32.8 μm is performed. In addition to it, the tape speed is slowed down to 18.7 mm/sec.
4. **Small Volume Tape**
   The tape thickness is reduced to 20 μm (in L-500).
   The thickness and the tape width of 1/2 inch reduce the volume of the tape.

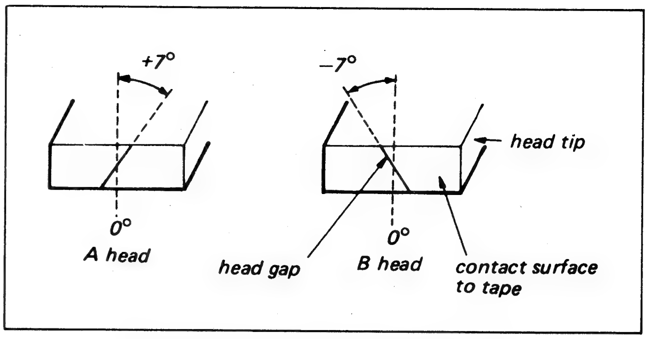


Fig. 3-1. Azimuth of video heads

A	Tape width	1/2 in. (12.65 mm)
B	Video Track width	32.8 μm
C	Video width	10.6 mm
D	Control Track width	0.6 mm
E	Audio Track width	1.05 mm

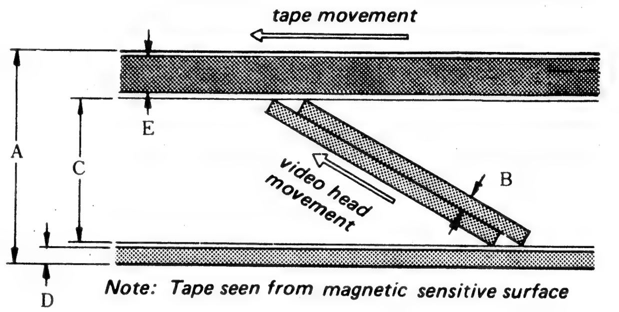


Fig. 3-2. Magnetic tape pattern

3-1-2. Colour Recording System

The PAL colour signal system is the Y and C separation system. The Y signal is FM-modulated and the chroma signal is frequency-coverted to a low frequency range for the AM recording.

The Y Signal is FM-modulated in a frequency deviation range from 3.8 MHz to 5.2 MHz in the FM modulator. If the chroma signal is down-converted from 4.43 MHz, a crosstalk interference due to the chroma signal recorded on the adjacent track is caused in the PLAYBACK mode because of the overlap recording.

For removing the crosstalk, a frequency difference of 1/4 fH is provided by setting the chroma signal frequency to be recorded on the A track to (44—1/8) fH and the one to be recorded on the B track to (44+1/8) fH and the signals having the 1/4 fH frequency difference are fed to the comb filter where the crosstalk is removed. Since the conversion carrier in the A field is 4.43 MHz+(44—1/8) fH in the PLAYBACK mode as shown in Fig. 3-4, 4.43 MHz is obtained as the chroma signal and 4.43 MHz—1/4 fH is produced as the crosstalk. See Fig. 3-4.

The wave cycle T of the 4.43 MHz chroma signal in one horizontal sync signal section is,

$$T = \frac{4.43359375 \text{ MHz}}{15.625 \text{ kHz} \times 2} = 284-1/4$$

In two horizontal sync signal sections, (284—1/4) x 2 = 586—1/2 waves exist. The 4.43 MHz—1/4 fH = (284—1/4) fH—1/4 fH = (284—1/2) fH which is the crosstalk component has the (284—1/2) x 2 = 567 waves in the two horizontal sync signal section.

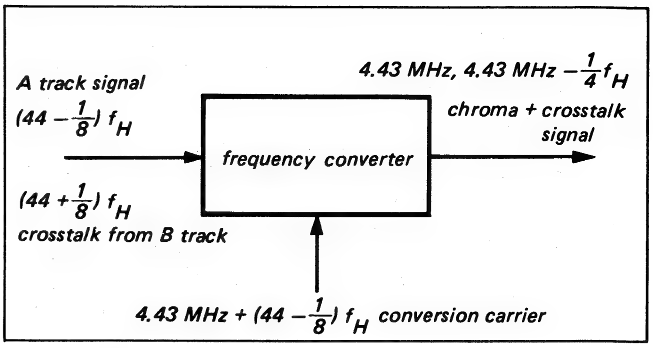


Fig. 3-4. Crosstalk removal in A field.

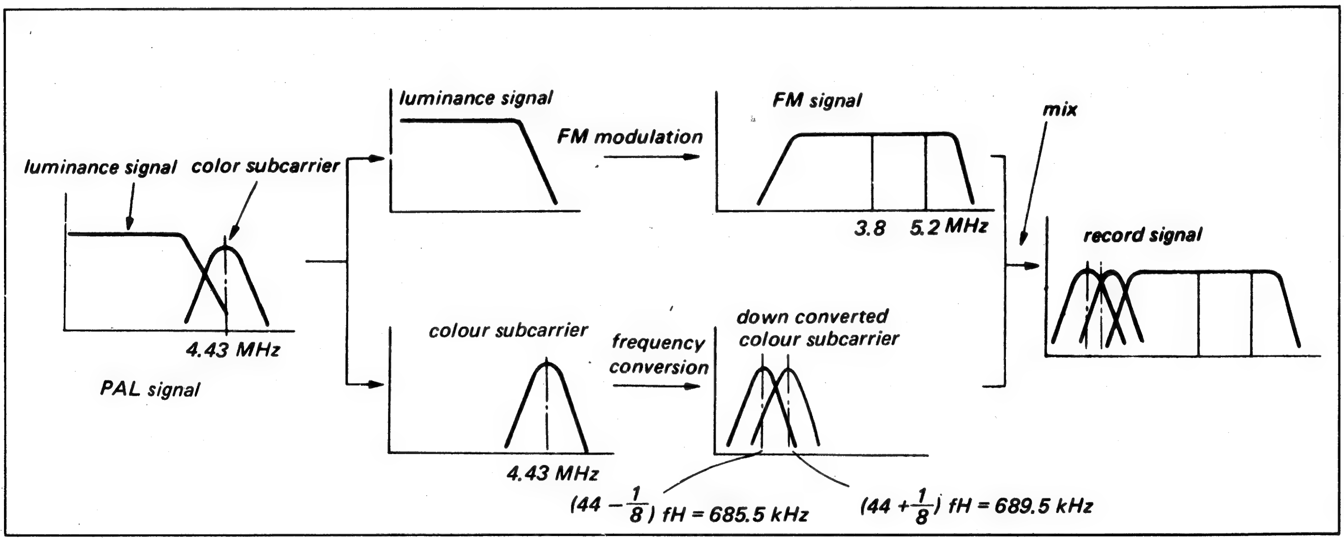


Fig. 3-3. Record signal frequency distribution

Since the 4.43 MHz chroma signal is an opposite phase in the 2H DL output and the 2H DL input and the crosstalk component is a same phase, if a subtraction is performed, only the 4.43 MHz chroma component can be extracted.
In contrast with the A field, 4.43 MHz as the chroma signal and 4.43 MHz+1/4 fH as the crosstalk component are produced in the B field and these are fed through the 2H comb filter in order to extract the 4.43 MHz component.

New APC and AFC systems are adopted for elimination of the phase variation of the chroma signal due to jitter, etc. in the record/playback processes. The conventional system (M system) eliminates the phase variation mainly in the APC circuit. The AFC circuit detects large variation in the tape speed with the playback horizontal sync signal and moves the operation point of the APC circuit, enlarging the APC lock range.
In this machine the low-converted chroma frequency for recording is (44±1/8) fH synchronized with the horizontal sync signal frequency (fH) of the video input signal. As shown in Fig. 3-5, the (44 x 8 ± 1) fH VCO (Voltage Controlled Oscillator) produces a signal (44 x 8 ± 1) times the horizontal sync signal and the produced signal is counted down to 1/8. The sum frequency of the counted-down signal, (44 ± 1/8) fH, and the output of the 4.43 MHz crystal oscillator is used as the frequency conversion carrier for removing the phase variation.
There is a loop which counts down the VCO output to $\frac{44}{44 \times 8 \pm 1}$ and to $\frac{1}{44}$ for the phase comparison with the comparison with the horizontal sync signal and controls the VCO with the difference signal obtained from the comparison. This loop is called the AFC.
The chroma and the Y-FM signals are recorded with the above frequency relationship.
The horizontal sync signal phase variation of the playback video signal is equal to approx. 44 ± 1/8 of the phase variation of the (44 ± 1/8) fH playback down-converted chroma signal. A signal (44 ± 1/8) times the frequency of the playback horizontal sync signal is produced in the AFC loop just as in recording. The frequency conversion, utilizing the sum frequency of the produced signal and the 4.43 MHz output of the crystal controlled oscillator, cancels the phase variation of the chroma signal. (See Fig. 3-7.)
Most of the frequency variation of the chroma signal is eliminated only in the AFC loop and the variation is eliminated in the common APC loop. In the APC loop, the phase of the pilot burst signal of the chroma signal converted to 4.43 MHz is compared with that of the reference 4.43 MHz crystal controlled oscillator and the variable frequency crystal oscillator is controlled by the obtained error voltage. The phase of the variable frequency oscillator output is compared with that of the burst signal of the input chroma signal in the RECORD mode to produce 4.43 MHz as pilot burst signal.

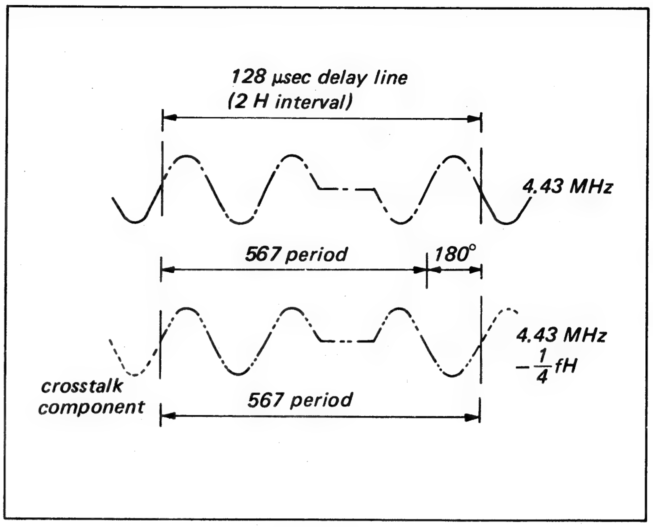


Fig. 3-5.

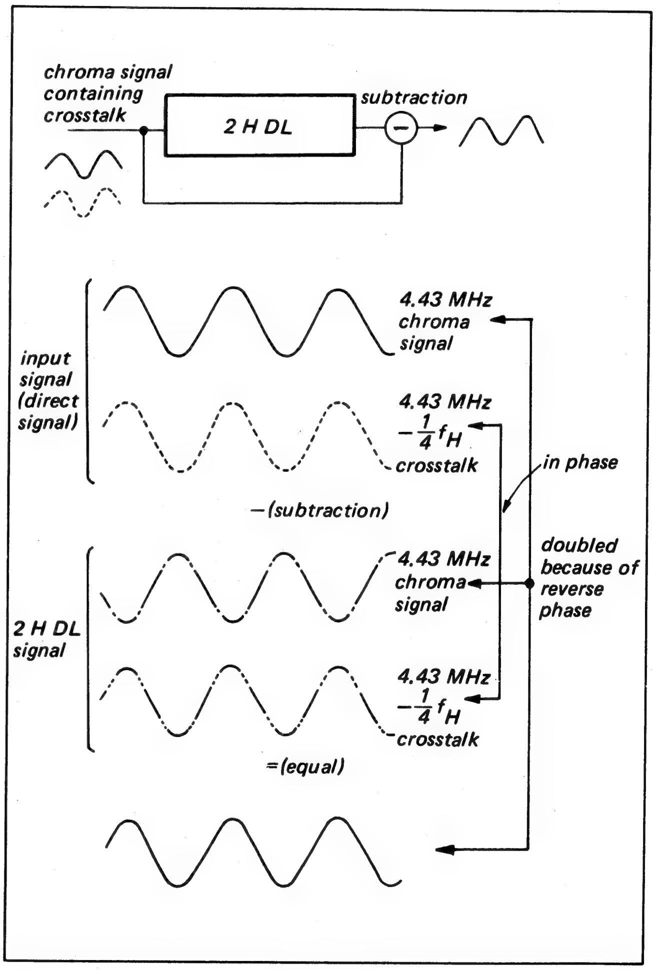
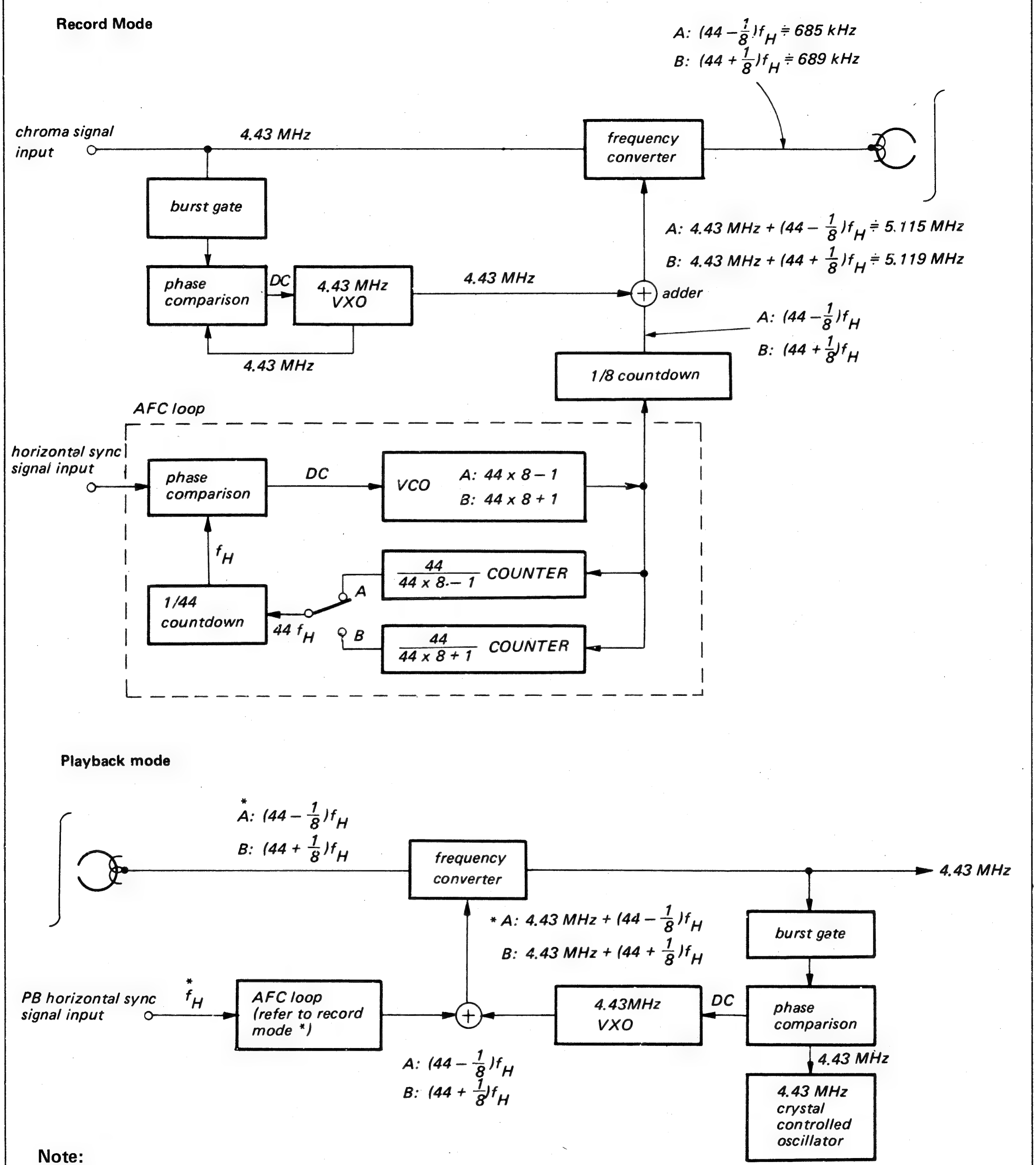


Fig. 3-6.



Note:

1. A and B denote the frequencies in the A and B fields respectively.
2. Signal marked with (*) contains phase variation components.

Fig. 3-7. APC, AFC Loop

3-2. VIDEO SYSTEM CIRCUITRY

The video system circuitry consists of the circuits on the PW2109 and the PW2108 boards.
The record/playback processing circuits for the chroma/luminance signals are on the PW2109 board. The video circuitry is highly integrated with ICs as shown in Fig. 3-8.

3-2-1. Luminance Signal System Circuit

The luminance signal system circuit has three ICs, TA7637P, CX134A, and TA7636P. TA7636P contains the process circuits of the recording system such as the AGC, clamp, FM modulator and other circuit. CX134A contains the playback pre-amplifier, RF switcher, limiter, and dropout compensator. TA7636P contains the FM demodulator, noise canceller, Y/C mixer, and other circuits.

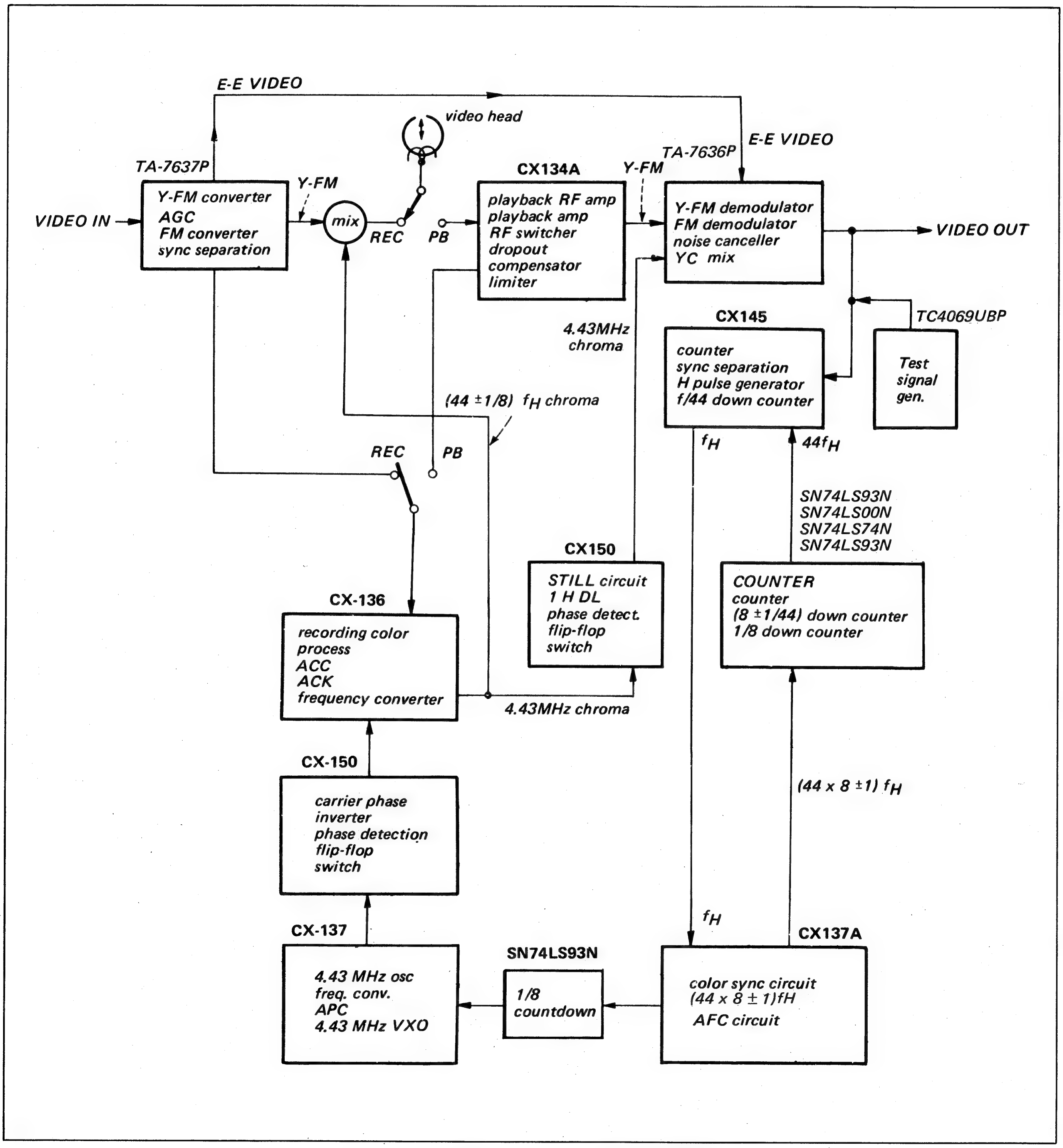


Fig. 3-8. **Video Circuit IC Block Diagram**

[Video Input]
The video signal supplied to the VIDEO IN connector is terminated by P012on the Antenna Terminal Board. The video signal obtained in the tuner block is supplied direct to Input Select switch S1 which selects TV or LINE IN.
The output from the Input Select switch S1 is supplied to the VIDEO IN (P201) terminal on the PW2109 and applied to pin 1 of IC401 (TA7637P) via attenuator (consisting of R341, R342).

[AGC Circuit and Y-FM Modulator] PW2109
IC401 (TA7637P) processes the video signal from the AGC to the FM modulator and supplies the Y-FM signal to the PW2108.
The video signal applied to pin 1 is regulated to a constant amplitude in the AGC circuit. The AGC is a sync type AGC. The standard ratio of the video signal to the sync signal (V/S ratio) is 0.7Vp-p to 0.3 Vp-p. A video signal level varies depending on the contrast ratio of a picture. A simple peak AGC system works to keep the composite video signal constant, which causes to vary the amplitude of the sync signal. Therefore the sync type AGC detects the sync amplitude, which is not related to the contrast ratio of a picture, and functions to make the amplitude constant. To detect the sync amplitude, a pulse is inserted into the back porch of the horizontal blanking of the video signal (See Fig. 3-9).

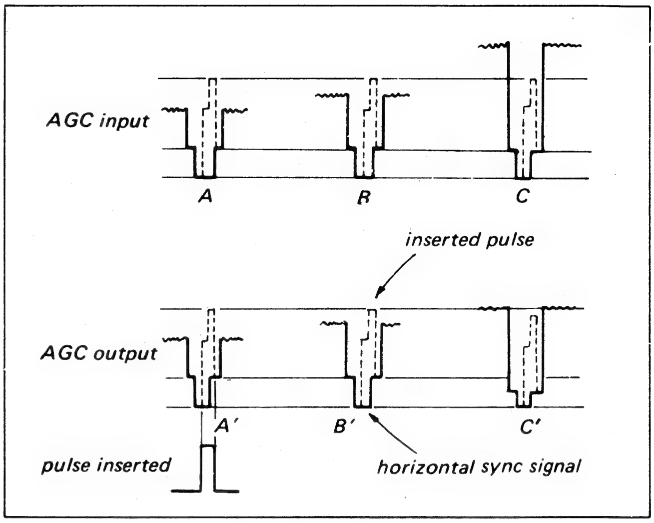


Fig. 3-9 Sync-AGC

The video amplitude is fixed by the pulse amplitude in the detection of the video signal and any variation in the sync amplitude can be detected. But when the video component in the input video signal is more than 105%, which is determined by R451, the peak AGC circuit functions so that the composite video signal becomes constant. The pulse inserted for the AGC is obtained by delaying the horizontal sync signal from the sync separator output.
The AGC circuit is shown in Fig. 3-10.

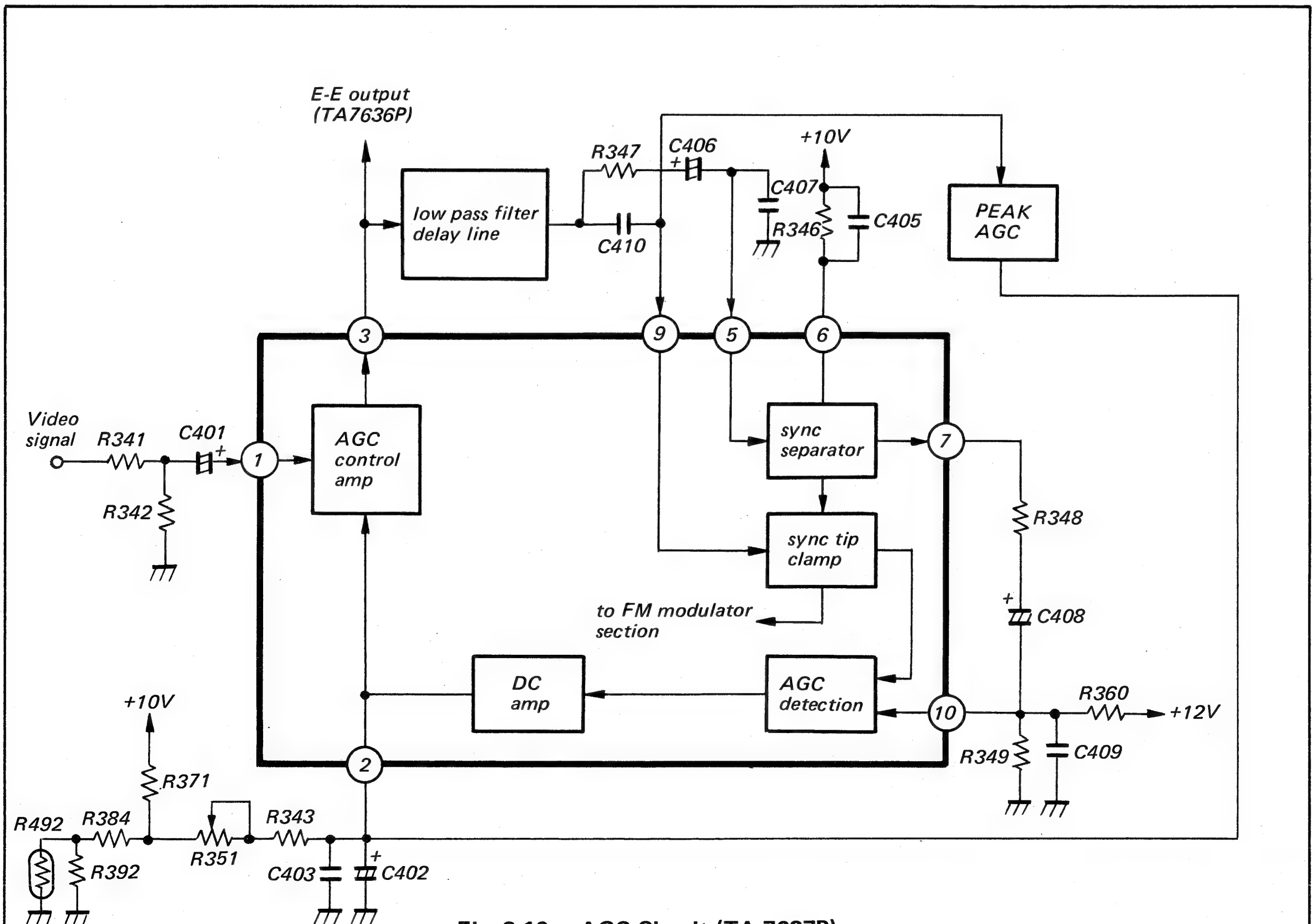


Fig. 3-10 AGC Circuit (TA-7637P)

The luminance signal output from pin 3 is supplied to the sync separation section at pin 5, the clamp and AGC detection section at pin 9 through low pass filter (Z301), 0.2μsec delay line (Z302) and buffer Q407.
The sync separator is between pins 5 and 7. It extracts the sync signal which is clamped by feedback and sliced. The R347 and C407 circuit connected to input pin 5 is a low pass filter for rejecting noise. The sync signal output from pin 7 is supplied through the AGC pulse mix circuit, to the AGC detection section from pin 10.

It is also supplied internally to the clamp stage for the sync tip clamp of the video signal. The signal applied to pin 9 is processed for the sync tip clamp with the sync separation output in the clamp stage and supplied to the FM modulator section and the AGC detection section.

The horizontal sync separation output is delayed in the integrator network consisting of R348, R349, R360, and C409, supplied to the AGC detection stage, and inserted into the horizontal blanking of the clamp circuit. (See Fig. 3-10.)
The integrator type pulse delay circuit is employed to eliminate noise in this machine instead of a differentiator type pulse delay circuit in former machines.

The delayed pulse inserted as shown in Fig. 3-9 so that it overlaps with the horizontal sync signal and the horizontal blanking porch. The detected output from DC amplifier in the IC is filtered by C402 and C403 at pin 2 and applied to the AGC control amplifier. (See Fig. 3-10.)

The circuit between pins 1 and 3 of IC401 (TA7637P) is the AGC control amplifier. The AGC control is changeability by current flows from power supply circuit to pin 2 and output of peak AGC circuit is added to pin 2. The AGC output from pin 3 is supplied to the direct E-E circuit. This E-E output is supplied to the PB/REC output switch circuit of IC402 (TA7636P). The E-E 4.43 MHz trap is controlled by Q408. Q408 turns off in the colour mode and does not function as a trap. In the B/W mode, the colour killer output becomes 0 V and Q408 turns on, acting as a 4.43 MHz trap.

The trap extracts the burst signal, not the chroma component in the direct E-E output, by the burst flag so that the B/W mode is set up on the monitor TV without fail when the B/W mode is set up on the VTR side in the RECORD mode by the functioning of the colour killer circuit.

The sync tipped video signal goes through the non-linear emphasis circuit and is frequency-modulated. (See Fig. 3-11.)

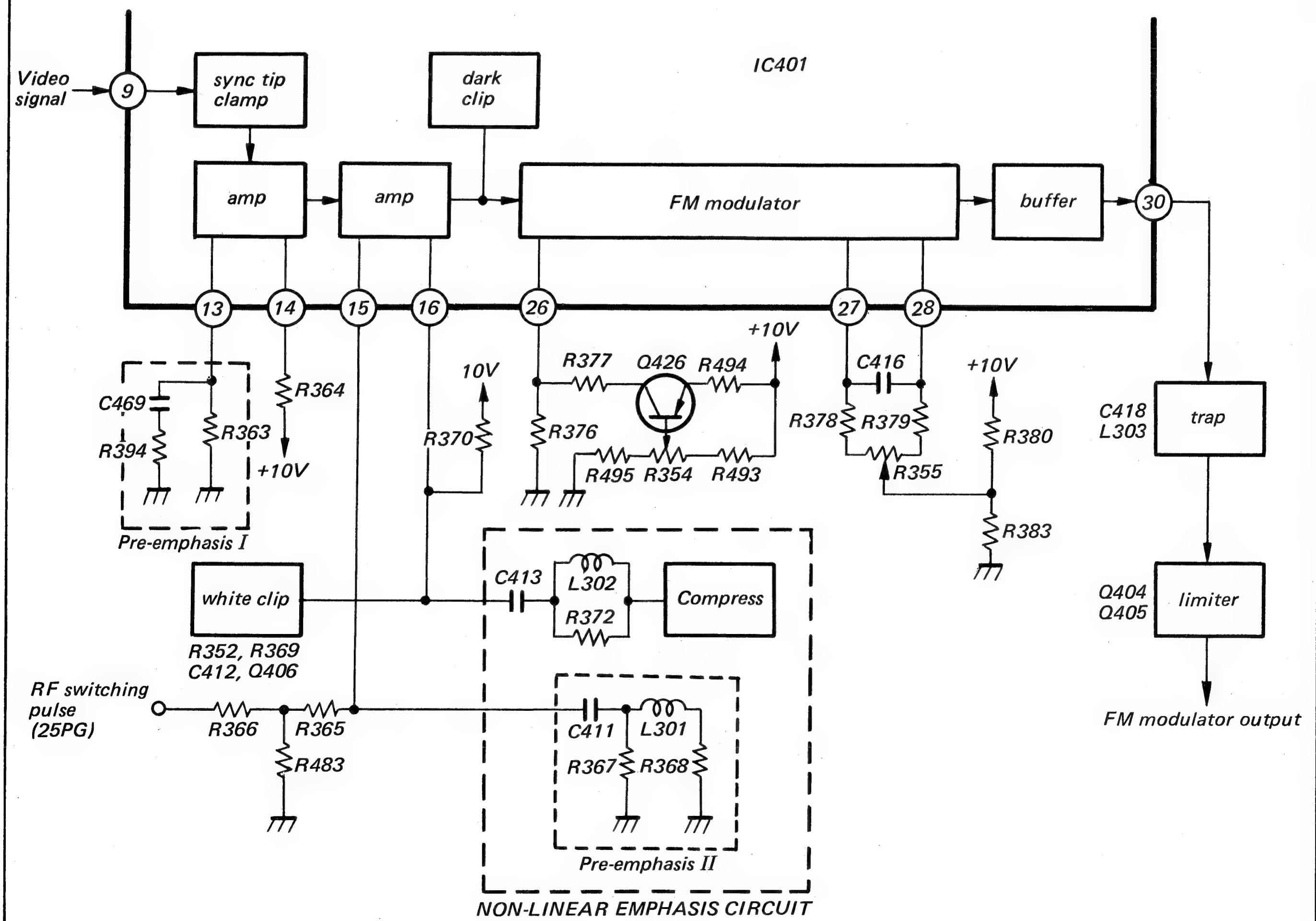


Fig. 3-11 Luminance Non-linear Pre-emphasis and FM Modulator Circuit

The non-linear emphasis circuit comprises the compress circuit and the pre-emphasis circuit and is connected to the pins 15 and 16 of IC401. The compress amount is adjusted with R353. The compress operation is performed by utilizing the non-linear characteristic of diodes D413 and D414 which are temperature-compensated by Q424. The white-clipped output is supplied to pin 16 of IC401 and frequency-modulated. The FM modulator employs an astable multivibrator which oscillates at the frequency determined by C416. The frequency varies in proportion to the level of the video signal applied to the modulator. The oscillating frequency is adjusted by varying the duty of the output waveform with R355 and the bias current with R354. The 1/2 fH shift is performed every field with the RF switching pulse. The deviation is adjusted by varying the AGC set current with R351 for varying the video signal amplitude.
The FM modulated output goes through the 685 kHz/689 kHz trap (consisting of C418 and L303), to Q404 and Q405 where it is limited softly, and is supplied to the record amplifier section on the PW2108.

RECORDING AMPLIFIER, PW2108
The Y FM signal applied from the Video Circuit board PW2109 is fed to the Y recording amplifier Q101 to amplify in a specified frequency response. The Y FM signal is further amplified by the succeeding amplifier Q102 to a level enough to activate the video heads. Before activation, the Y FM signal output of Q102 passes the output transformer T101, R114, and R115 to the record/playback switch S101. The selected signal is applied through the terminal P101 and the rotary transformers T301 and T302 to the video heads. Similarly, the low frequency (685 kHz/689 kHz) converted chroma recording signal applied from the Video Circuit board PW2109 is amplified through the chroma recording amplifier Q103 to a level enough to activate the video heads. Before activation, the chroma signal output of Q103 passes R117 and R116 to mix with the Y FM signal. The Y FM signal and chroma signal are frequency-mixed in each path to the video head, as the Y FM signal has been high-passed above the chroma signal band as stated.
L101, connected to the emitter of Q103, compensates the differential characteristic of the video heads in a decreasing frequency response of 6 dB/oct. The Y FM signal is recorded or played back at a rather high signal-to-noise ratio as it serves like the high-frequency AC bias in an Audio Tape recorder, while the chroma signal is AM-recorded.

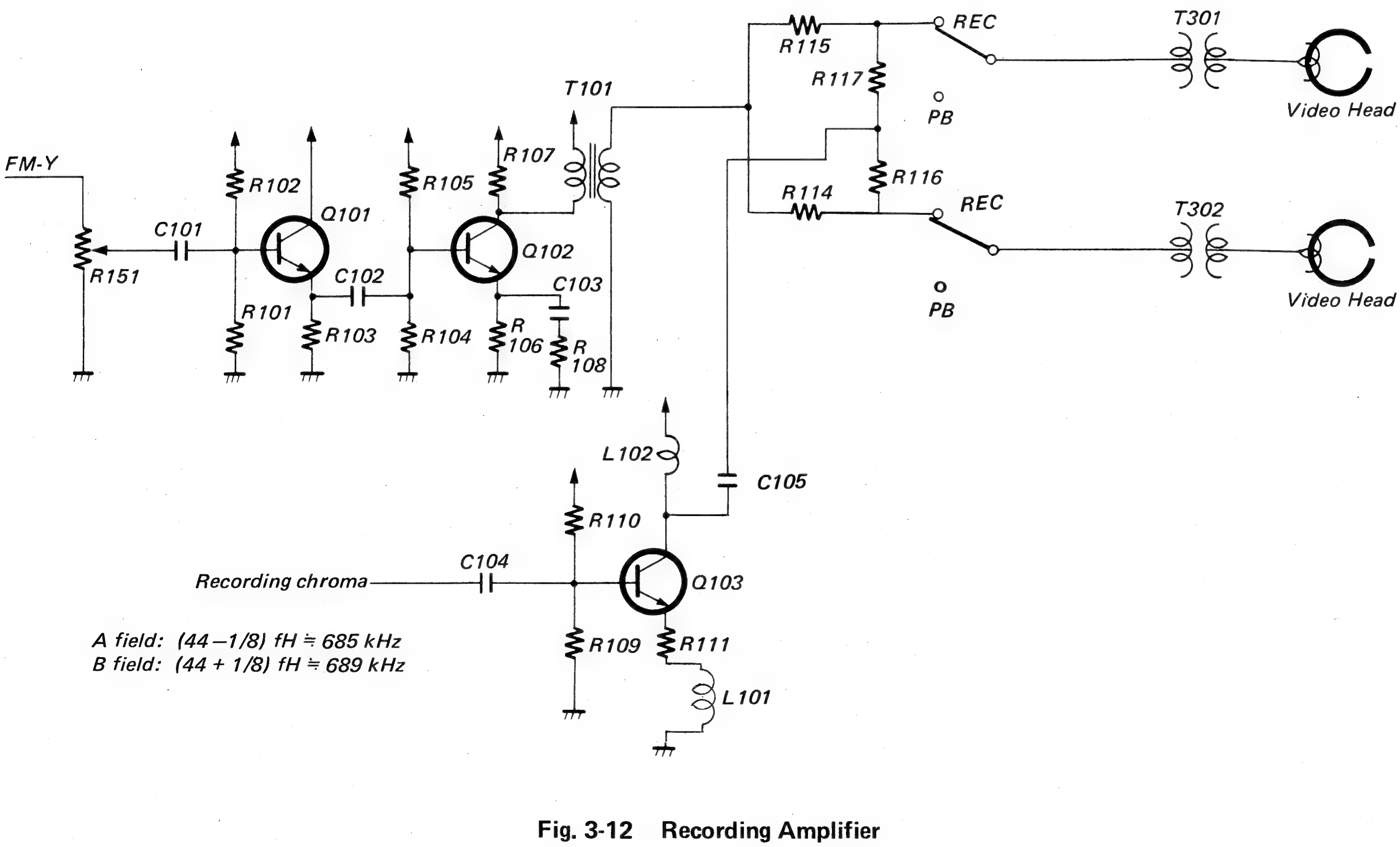


Fig. 3-12 Recording Amplifier

The RF signals output of the RF switchers pass the amplifiers and emitter followers to pins 16 and 17. The output signals in the two routes are mixed in the resistor network, consisting of R125 and R126, to form a serial signal as a playback input signal.
The serial signal the chroma component of which is eliminated through the high-pass filter, consisting of C117, C118 and L110 is fed to pin 14.
The RF signals containing the chroma component, also, are mixed in series by R123 and R124. The serial signal is supplied to pin 2 of the terminal P202 on the Video Circuit board PW2109.
In the special playback operation, such as slow, still and frame by frame, MODE signal is applied from Speed control circuit PW2117 to pin 3 of IC108 to stop the DOC operation.
Because, trigger level of Schmit trigger circuit is locked out by this MODE signal.
The Y FM signal passes the limiter amplifier, which prevents possible waveform distortion for excessive input signal, but not acts as limiter. The main limiter, which has a limiter gain around 25 dB, restricts the amplitude of the playback Y FM signal to eliminate a change of the signal amplitude. The signal output of the main limiter normally passes the DOC switch to the output amplifier, the signal output of which is fed out from pin 4.

The playback Y FM signal at pin 4 passes the emitter follower Q106, the output of which is applied through pin 25 of the terminal P103 on PW2108 and pin 6 of the terminal P202 on PW2109 to the FM demodulator in IC402 (TA7636P). The output of Q106, also, is fed to the 1 H delay line. The 1 H delayed signal is connected through pin 6 of IC108 to the DOC switch.
The DOC limiter slightly restricts the signal to eliminate a change of the signal amplitude other than a dropout portion on the tape, if any. The output of the DOC limiter is detected as pulse by the detector R135, and C124 connected to pin 7 smooths the detected dropout pulse. The dropout signal is fed to the Schmitt trigger, which shapes the waveform to switching pulse. R156 is used to adjust the DOC level, or the dropout compensation sensitivity of the Schmitt trigger. The DOC switch, then, is turned to pin 6 to allow the 1 H delayed signal to be inserted in place of the dropout line. This prevents the dropout from deteriorating the picture quality. The detected dropout pulse, also, turns on or off Q107, connected to pin 2, to short or open R136 accordingly. This provides a on-off hysteresis effect for the DOC switch.

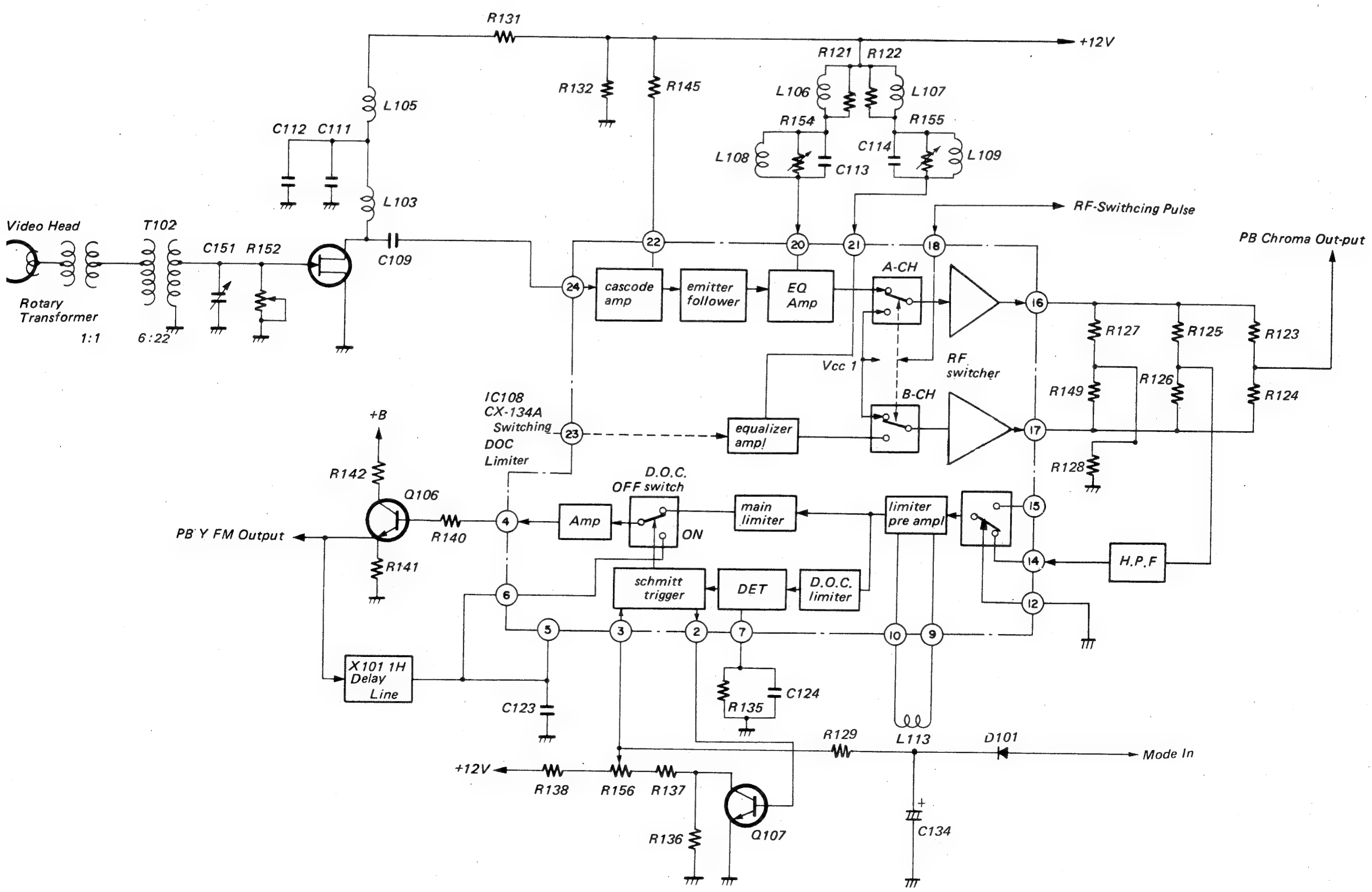


Fig. 3-13 Playback Amplifier

[Y-FM Demodulator Circuit]

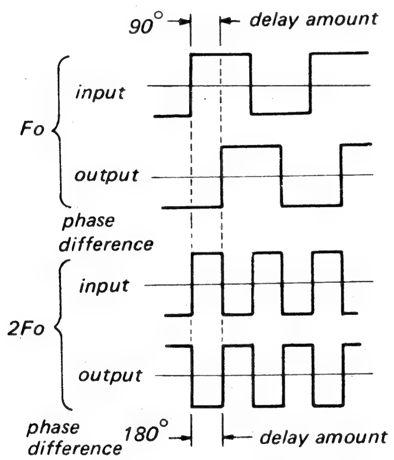
The playback Y FM signal supplied from IC108 on the PW2108 is applied to IC402 (TA7636P) on the PW2109.

TA7636P contains the FM demodulator, de-emphasis, noise canceller, Y/C mixer, and REC/PB switch. This IC has all the active circuits from the demodulator to the video output in the playback system of this VTR.

The pulse counter type and the delay line type have been used for the FM demodulation of VTRs. The demodulator in TA-7636P is multivibrator type. In this type of demodulator, a multivibrator is used as a delay circuit. An astable multivibrator is injection-locked by the Y FM signal. It is utilized that the phase difference between the multivibrator output and the input FM signal is proportional to the FM frequency.

When the multivibrator is locked, the delay time of the multivibrator output against the input FM signal becomes constant without regard to its frequency.

Assume that the free running frequency of the multivibrator is Fo. If a frequency of Fo is applied, the phase difference between the input and output becomes 90 degrees. It becomes 180 degrees for a frequency of 2 Fo. This astable multivibrator is the same type as that used in the FM modulator in TA-7637P.



Fo: free running oscillating frequency of multivibrator

Fig. 3-14 Injection Lock Input and Output Signals

Since the phase difference between the input and output of the multivibrator is proportional to the input frequency, a detected output proportional to the frequency can be obtained by using a phase comparator (multiplier). This type of demodulator is far less sensitive to amplitude variations in the FM signal than some other demodulators previously used. This permits the use of a much simpler limiter preceding it. Fig. 3-15 shows the block diagram of the FM demodulator section.

VIDEO PLAYBACK AMPLIFIER AND DOC, PW2108

The video playback amplifier IC108 (CX134A), consisting of a pair of playback preamplifiers, a pair of RF switches, a limiter, and a DOC (dropout compensator) sufficiently amplifies the signal picked up by the video heads, compensates the frequency response, limits the Y FM signal amplitude to a certain level, and feeds out the signal to the Y FM demodulator in the succeeding IC402 (TA7636P) on PW2109. With respect to the two pairs of playback preamplifiers and RF switchers for the video heads A and B, or the fields A and B, the two are identical in the construction; therefore, those in the route A alone will be described here.

The very small signal picked up by the video head H012 passes the rotary transformer T302, record/playback switch S101, and step-up transformer T102 to the FET amplifier Q104. The inductance of the video head and the capacitance of C151 are made to resonate to compensate the response at high frequencies around 5.2 MHz. Q104 is connected through pin 24 to the amplifier inside IC108 to form a cascode amplifier. The signal output of the cascode amplifier passes an emitter follower to an equalizer amplifier, including L108, R154, and C113 connected to pin 20, which compensates the mid-range frequency response around 3 MHz. The signal output of the equalizer amplifier is fed to the RF switcher.

To pin 18 is connected the RF switching pulse of 30 Hz that has been picked up by the PG coils 1 and 2 and amplified through IC501, Q515, and Q514 on the Servo and Logic Circuit board PW2110. In the field A, when the RF switching pulse at pin 18 is zero, the signal at pin 20 is switched to input; when it is around 5 V, the signal is switched over with the Vcc line. In the field B, the reverse switching operation is performed. Now, the RF signal having the overlapped part of the both fields eliminated is obtained.

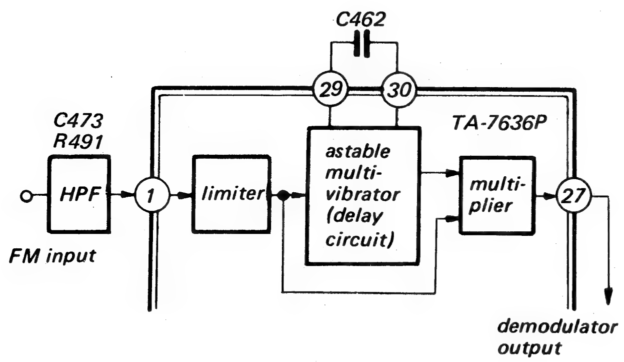


Fig. 3-15 FM demodulator circuit, TA-7636P

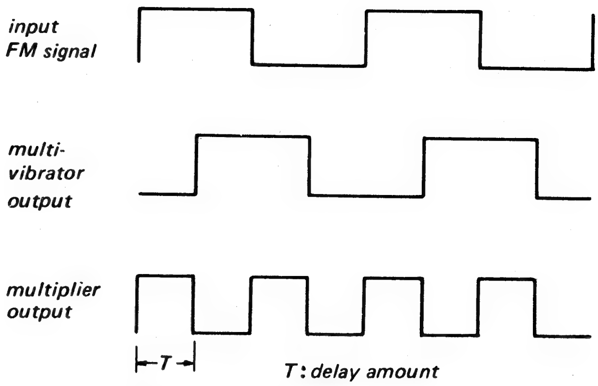


Fig. 3-16 Multipler Waveform

The Y FM signal from the PW2108 is supplied to the high pass filter (consisting of C473 and R491) where its AM component is removed. Then the signal is applied to pin 1 of TA-7636P.
The FM demodulator is arranged with the limiter, multivibrator, and multiplier. The limiter limits the input FM signal and supplies it to the multivibrator and the multiplier. The multivibrator stage works as a delay circuit. The multivibrator used in the stage is the same astable multivibrator type used in the FM modulator in TA7637P. It oscillates at a free running frequency Fo, determined by capacitor C462, when no signal is applied. The FM signal is applied to this multivibrator which injection locks to it. As described previously, the phase difference between the output and input signals of the multivibrator is proportional to the input frequency. The multivibrator output and the input FM signal are both applied to the multiplier. The multiplier functions essentially as a phase comparator which develops a dc component proportional to the frequency by utilizing the fact that the phase shifts of the input and output of the multivibrator are proportional to the frequency. (See Fig. 3-16.) As shown is Fig. 3-16, the input FM signal and the multivibrator output are multiplied in the multiplier (AND).

This multiplier is a double balanced type. The output of the multiplier is supplied from pin 27 to the following low pass filter. See Fig. 3-17.
The demodulator output at pin 27 goes to the low pass filter(Z304) where its carrier component is rejected. The video signal which is extracted the carrier components enters the wave shaper circuit. (See Fig. 3-13.)
The video signal goes through the emitter peaking amp (Q416), the phase correction circuit (Q415, C448, C449, R445, and L309), the smear correction circuit (Q414), and 1/2 fH shift restoring circuit (R439, R440, R441) and is supplied to the non-linear de-emphasis circuit.
the de-emphasis circuit, the expand circuit and the carrier leak trap. The de-emphasis circuit and the expand circuit have the opposite characteristic against the one of the emphasis circuit and the compress circuit in the recording process.
The emitter peaking amplifier corrects the frequency characteristic around 2 MHz. The smear correction circuit corrects the clipped signal for the white and dark clip in the recording.
The video signal processed in these circuit is a high grade signal and supplied to the noise canceller circuit.

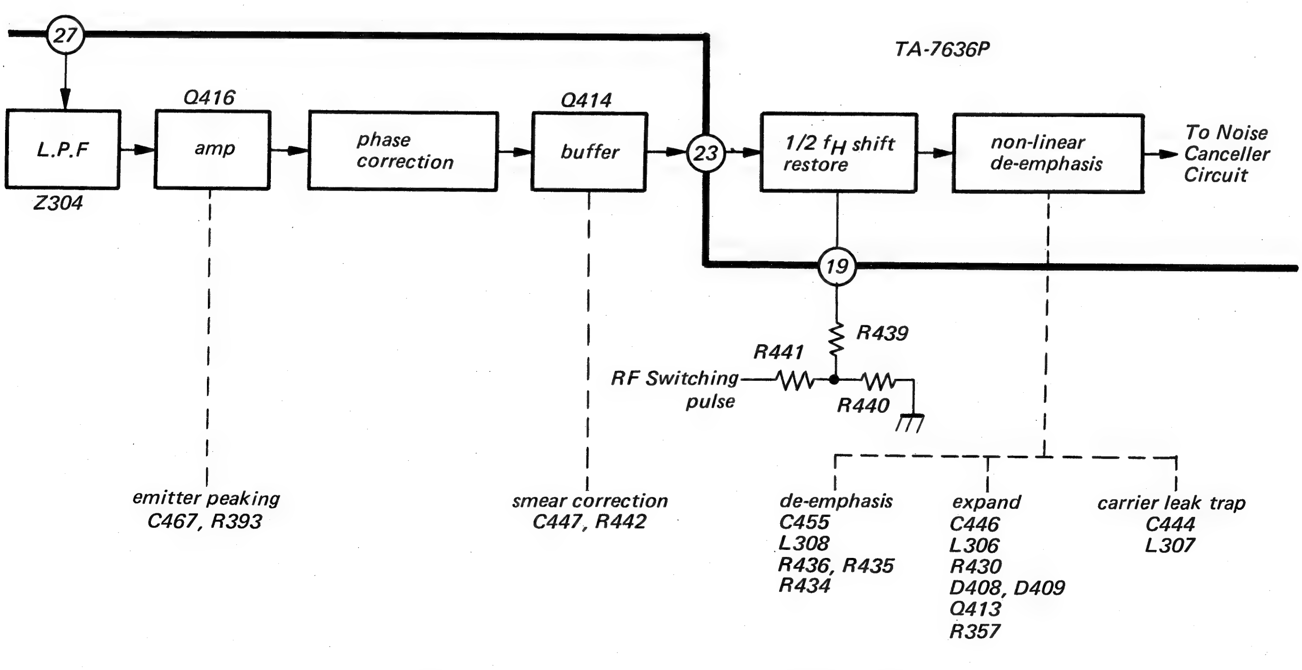


Fig. 3-17 Playback Waveform Shaper Circuit

[Noise Canceller Circuit]

The block diagram of the noise canceller is shown in Fig. 3-18.

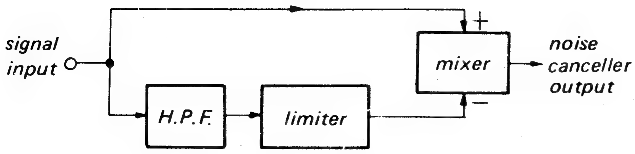


Fig. 3-18 Noise Canceller

The high frequency component in the video signal is extracted in the high pass filter and any remaining high frequency signal components are rejected in the limiter. This leaves only the high frequency noise component. This noise component is added to the video signal, 180° out of phase and the same amplitude with it. By this process, the noise component is cancelled. Fig. 3-19 shows the noise canceller circuit.

The signal applied from non-linear de-emphasis circuit is supplied to the gain adjusting amplifier. The gain of this amplifier is adjusted by varying the negative feedback from pin 14 to pin 15 with R356.

This adjusts the playback level of the Y signal. The output from pin 14 is supplied to the highpass filter (consisting of C439, C438, and R420) which extracts only the high-frequency portion of the video signal. The filter output is supplied to the limiter inside the IC. The signal component with large amplitude is rejected in the limiter and the remaining is only the low amplitude noise component. The noise component is then applied to the adder circuit. The added noise component is 180° out of phase with the noise

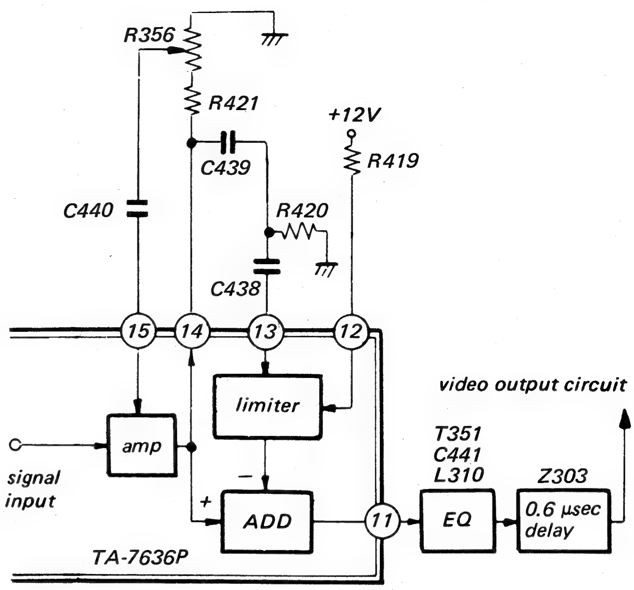


Fig. 3-19 Noise Canceller Circuit

phase in the original signal and has the same amplitude with the noise amplitude in the signal. The noise component is cancelled in the addition process. The output of the noise canceller circuit is supplied to the Y/C mixer circuit in the video output stage from pin 11 via the equalizer circuit (consisting of T351, C441, and L310) and the delay line (Z303. . . 0.6 μsec).

[**Video Output Circuit**]

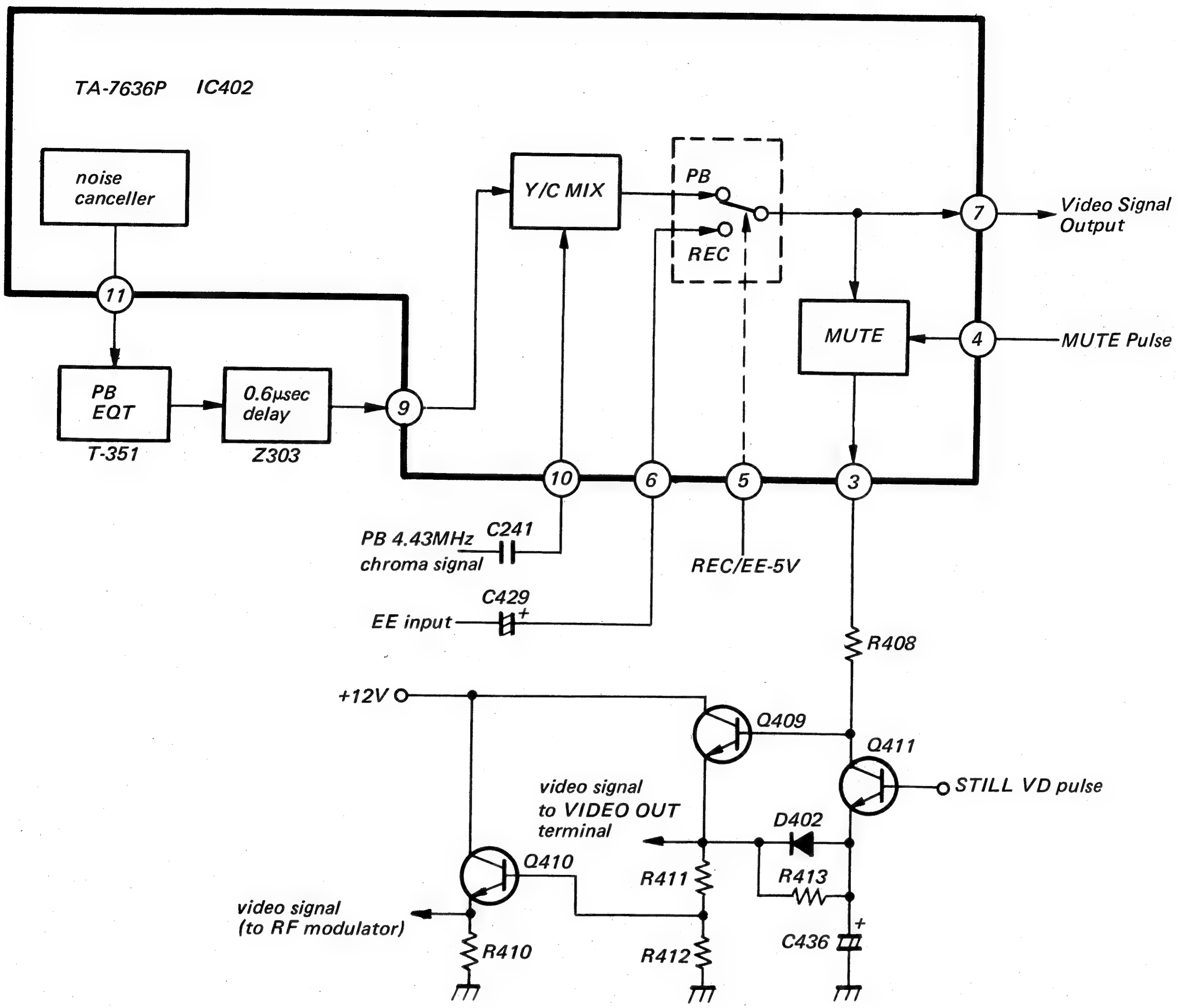


Fig. 3-20 Video Output Circuit

The video output circuit consists of the Y/C mixer, colour killer, record/playback switching circuit, and muting circuit. The demodulated video signal is applied to pin 9, the input of the Y/C mixer. The playback chroma signal is applied to pin 10, and mixed with the Y signal in the Y/C mixer. The output of the Y/C mixer is fed to the record/playback switching circuit. The direct E-E signal is applied to the record side of the switch from the AGC circuit. The signal is for monitoring the input video signal when the machine is in the REC/E-E mode. Pin 5 is the switch voltage input and 5 Vdc is applied in the REC/E-E mode. The switch is switched to REC when pin 5 is 5 V and to PB when pin 5 is 0 V.

The video output from pin 7 is supplied to the chroma system AFC circuit. The video out from pin 3 is supplied to the RF modulator via the buffer (Q410), and the VIDEO OUT terminal via the buffer (Q409).

[STILL VD Insertion Circuit]

The STILL VD insertion circuit inserts a stable VD with a good S/N ratio produced from PG pulse into the composite video signal for stabilization of the vertical direction of the picture.

The Noise Mask pulse supplied from Servo and Logic board PW2110 turns Q428 and Q429 on and makes the emitter level of Q409 as same as gray pattern level of color bar to cut the noise component. At the same time, HD pulse produced in the IC208 is applied through Q231 and Q429.

And then, when the STILL VD pulse is applied to the anode of D406, Q411 is turned on because STILL IN signal is supplied to the base of Q411. Therefore, the Video signal is sync-Tip-clamped or VD pulse is inserted by above mentioned.

In the special playback operation, such as a slow, a still or Frame by Frame, Q412 is turned on by STILL IN signal and muting signal is cut because the level at pin 4 is low.

[Test Signal Generating Circuit] TC4069UBP

When 12 V is supplied from the TEST 12 V IN, TC 4069UBP oscillates a horizontal sync frequency of 15.625 kHz and the waveform shown in Fig. 3-22 is supplied to the RF modulator from the VIDEO OUT (RF).

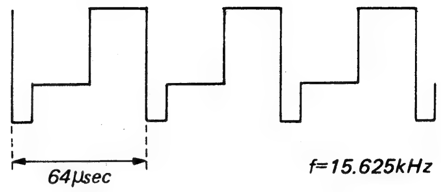


Fig. 3-22

Q410 and D404 form the switching circuit. The video signal is supplied from the D404 side to the RF modulator only when the TEST 12 V is existing. In other modes, the signal is supplied to the RF modulator from Q410.

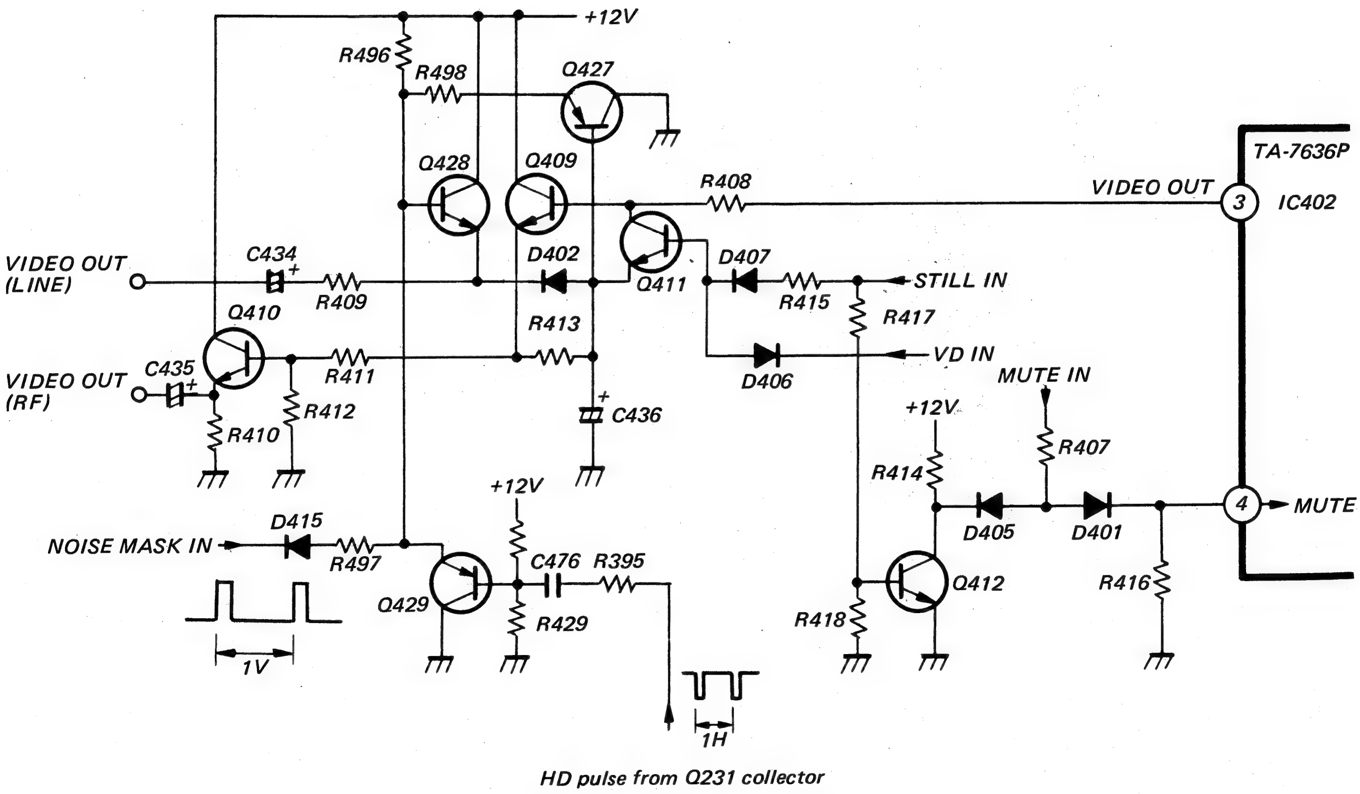


Fig. 3-21 STILL VD Insertion Circuit

3-2-2. Chroma Signal System

The chroma recording system is a new system. It is identical with the former one in respect of the low-converted dc recording but the recording pattern on the tape is different. It is a new overlap record system. The detail of this system is described in Section 1-2-2 "Colour Recording System". The differences of the new system from the former one are the following two points.

(1) Recording is made with different chroma signal frequencies on tracks A and B. The frequency difference is 1/4 fH.

(2) The frequency of the low-converted chroma signal processed in the new AFC and APC systems synchronizes with the horizontal sync signal frequency of the input video signal.

The simplified block diagram of the chroma system is shown in Fig. 3-23.

RECORD Mode

The input 4.43 MHz chroma signal is applied to the frequency converter. The carrier signal of 4.43 MHz + (44 - 1/8) fH = 5.11 MHz in the A field and 4.43 MHz + (44 + 1/8) fH = 5.12 kHz in the B field are applied to the frequency converter.

The chroma signal is converted to the (44 - 1/8) fH = 685 kHz for the A field and the (44 + 1/8) fH = 689 kHz for the B field. These carrier signals are produced as follows. The AFC loop produces the (44 x 8 - 1) fH A field signal and the (44 x 8 + 1) B field signal in the RECORD mode from the H. sync separated from the input video signal. (The A and B fields denote the fields on which the A and B heads perform recording. The fH means the horizontal sync frequency.)

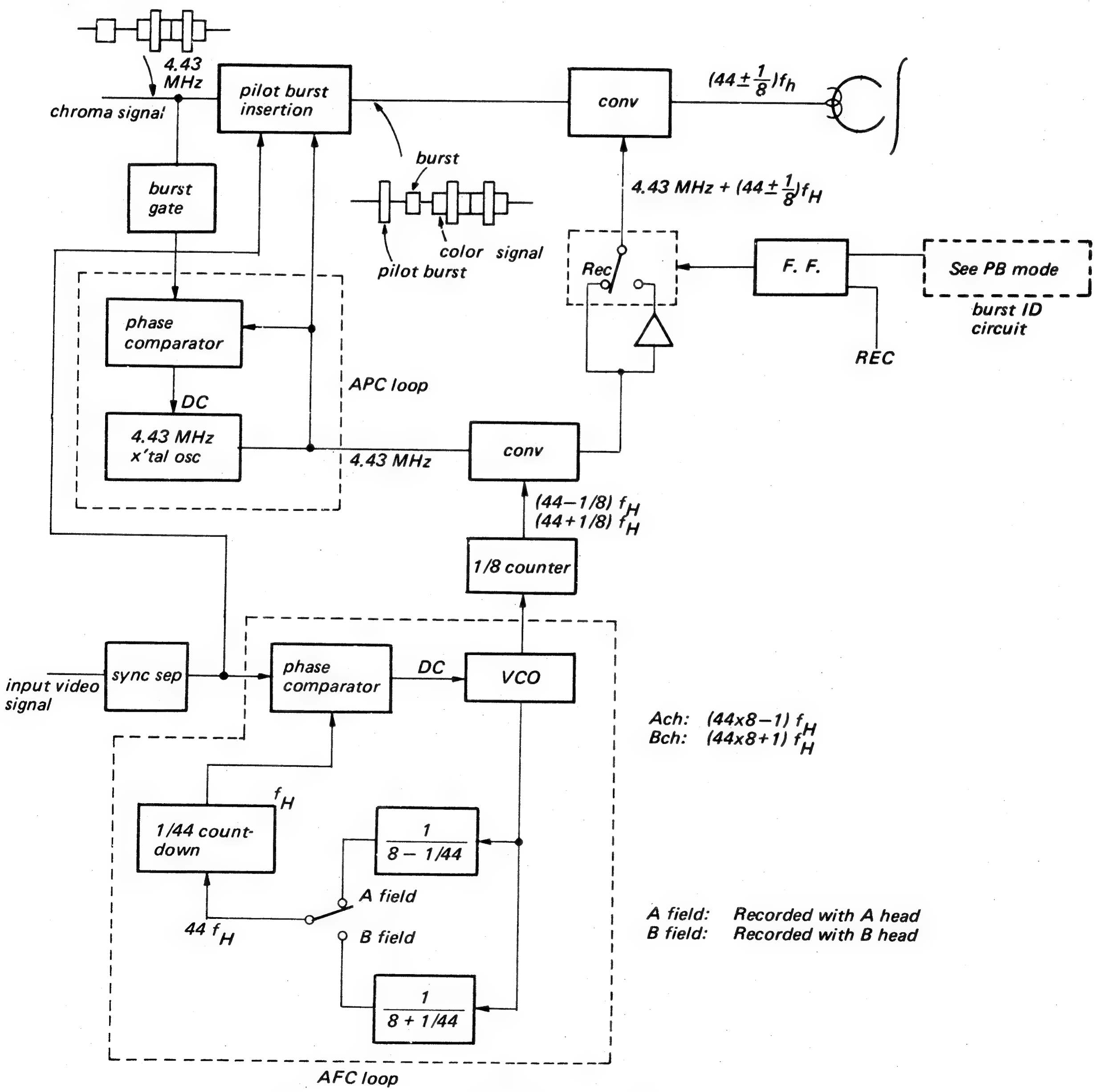


Fig. 3-23 Simplified Block Diagram of Chroma System

The AFC loop forms a PLL (= Phase Locked Loop) circuit and counts the (44 x 8 ± 1) fH outputs from the voltage controlled oscillator down to $1/44 \times \frac{1}{8 \pm 1/44}$ compares the phase of the converted outputs with that of the H. sync, and controls the oscillator with the resultant error voltage. Thus the (44 x 8 ± 1) fH signal synchronizing with the horizontal sync signal frequency fH is obtained. The signal is divided by 8 to (44 -1/8) fH = 685 kHz for the A field and (44 +1/8) = 689 kHz for the B field and the obtained signals are applied to the frequency converter circuit. Since the 4.43 MHz crystal oscillator output is also applied to the frequency converter from the APC loop, the converter outputs are the sum frequency of the two signal, 4.43 MHz + (44 ± 1/8) fH = 5.119 MHz (for A field) and 5.123 MHz (for B field).
The 5.119 MHz and the 5.123 MHz outputs are supplied to the chroma frequency converter. The resulted chroma signal frequencies converted to 685 kHz and 689 kHz are recorded. The chroma frequencies are synchronized to fH, horizontal sync signal frequency and have the relationship of the (44 -1/8) fH and the (44 + 1/8) fH. The APC loop compares the phase of the 4.43 MHz variable crystal oscillator output with that of the burst signal to control the variable crystal oscillator with the obtained error voltage. Therefore the phase relationship between the 4.43 MHz output and the burst signal is kept constant.

The circuit to insert the 4.43 MHz output into the horizontal sync signal section of the input chroma signal is a pilot burst insertion circuit. Since the pilot burst signal is recorded about 6 dB larger than the original burst signal, it is utilized in the APC (= Automatic Phase Control) in the PLAYBACK mode because of the improved S/N ratio.
The low-converted chroma signals of 685 kHz and 689 kHz are recorded on the tape together with the frequency-modulated luminance signal.

PLAYBACK Mode
The (44 -1/8) fH 685 kHz and the (44 +1/8) fH chroma signals separated from the playback output from the video head are converted to 4.43 MHz in the frequency converter. The 4.43 MHz + (44 -1/8) fH = 5.119 MHz and the 4.43 MHz + (44 + 1/8) fH = 5.123 MHz carrier signals are applied from the same circuit used in the RECORD mode. The input signal to the APC loop in the PLAYBACK mode is the horizontal sync signal separated from the playback video signal. The 4.43 MHz variable frequency crystal oscillator is controlled by APC loop output.
The chroma signal was recorded with the (44 ±1/8) fH frequency synchronized with horizontal sync signal fH. When the signal recorded in such a way is played back, the relationship between phase variation Y of the horizontal sync signal of the playback video signal and phase variation X of the playback chroma signal is X = (44 ±1/8) Y. The AFC loop produces the (44 ± 1/8) fH output synchronizing with the playback sync

PB mode

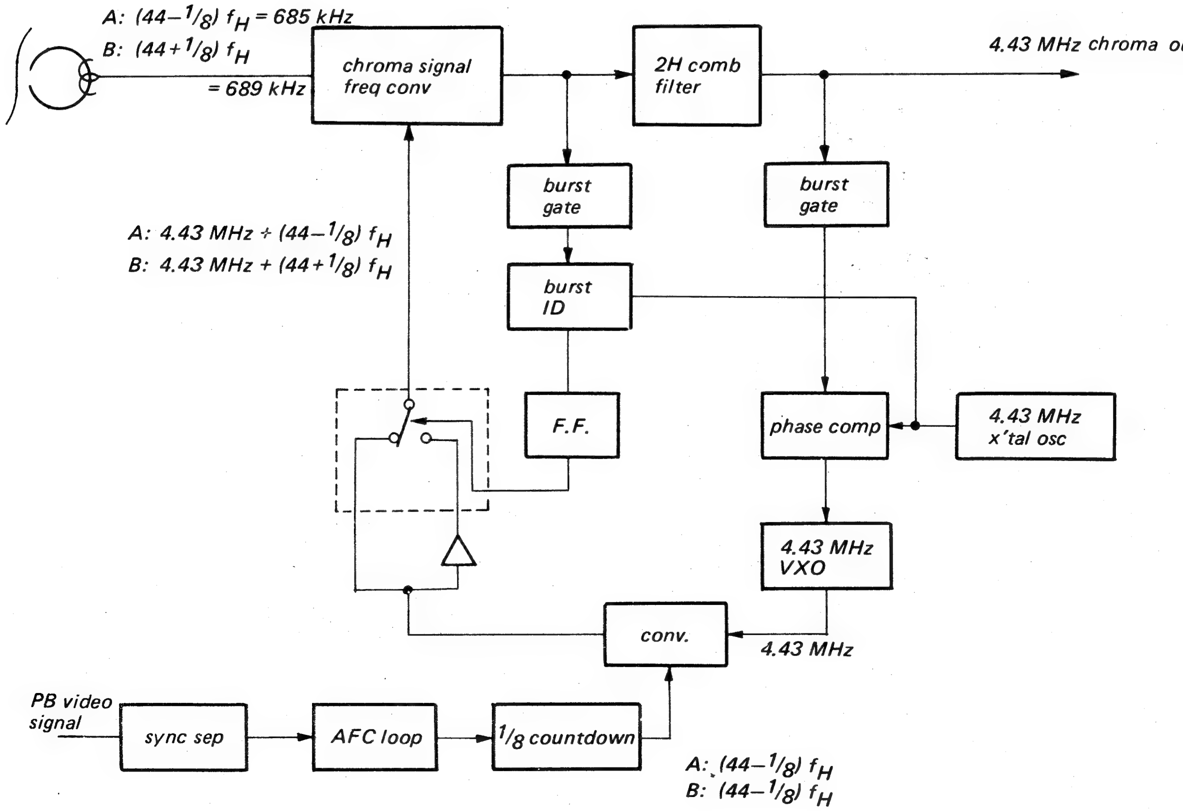


Fig. 3-24

signal. The output contains the phase variation component equal to that in the chroma signal. The phase variation in the chroma signal is cancelled in the frequency conversion process and the 4.43 MHz chroma signal with a stable phase is obtained. The phase variation of the chroma signal is almost removed only in the AFC loop, i.e., the horizontal sync signal is utilized as the pilot signal.

The APC loop is used to remove more small phase variations. The 4.43 MHz pilot burst signal was inserted into the horizontal sync portion in the recording. In the PLAYBACK mode, the phase of the pilot burst signal of the chroma signal converted to 4.43 MHz is compared with that of the 4.43 MHz crystal oscillator output to obtain the error voltage for controlling the 4.43 MHz variable frequency oscillator. Thus the phase of the playback chroma signal is stabilized. Since the APC loop does not work properly in such a case that the phase of the playback chroma signal inverts 180°, the burst ID circuit shown in the figure is provided for prevention of the disorder due to the 180° inversion. The circuit compares the phase of the 4.43 MHz crystal oscillator output with that of the pilot burst signal and when the phase inversion of the pilot burst signal is detected, it feeds a trigger to the flip-flop to restore the switch phase to the normal state.

The crosstalk from the adjacent tracks to the playback chroma signal is removed in the 2 H comb filter.

The above is a brief explanation of the colour recording system and the detail of each section is described below.

The chroma signal process circuit is on the PW2109 board. It is arranged with 8 ICs [CX136A, CX137A (two), CX145, CX150(two), and CX130(two)] and 4 ICs [SN74LS93N (two), SN74LS00N, and SN74LS-74N]. The four ICs form TTL.

CX136A contains the chroma process circuit for record and playback, the APC circuit, the AFC circuit, and the two frequency process circuits, and supplies the carrier signal to the frequency converter circuit of the chroma signal.

[Chroma Signal Process] CX136A

IC201, CX136A used for both the record and playback as the chroma signal process circuit functions as the ACC (= Automatic Chroma Level Control), the frequency conversion, and the color killer.

The switching of the record and the playback is performed by the external switching circuit consisting of Q213, Q214, Q221, and Q222.

Record System Chroma Signal Process

The block diagram of the record system chroma signal process and its peripheral circuit are shown in Fig. 3-25.

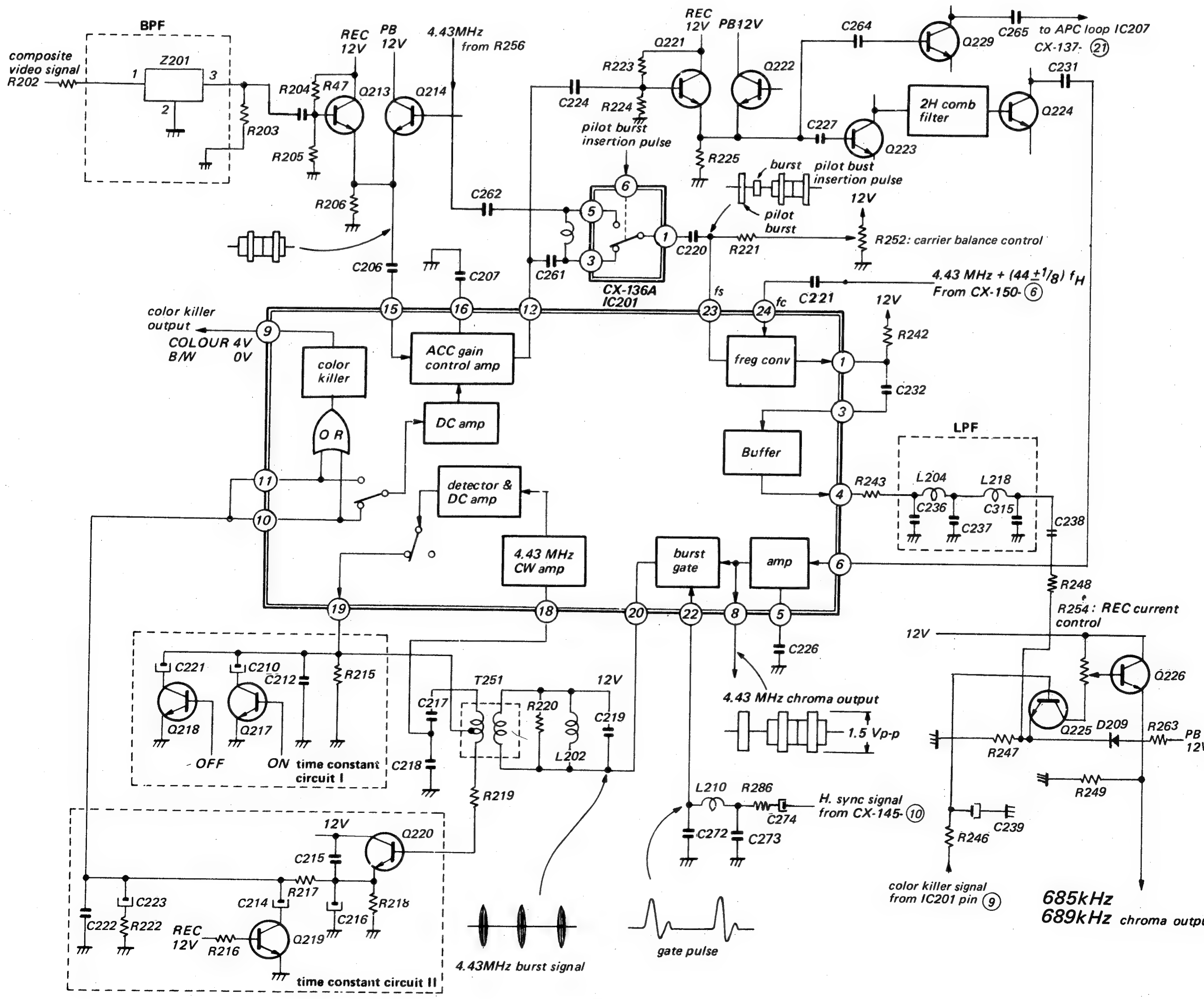


Fig. 3-25

The composite video signal supplied to the VIDEO board is fed into two paths. One is fed to the AGC circuit (in TA7637P) and the other to the chroma process circuit via the band pass filter. The band pass filter (Z201) extracts only the 4.43 MHz chroma portion. The extracted chroma signal enters the ACC gain control amplifier (pin 15) via Q213. Since Q213, Q214 form a switching circuit and a voltage is applied to the Q214 circuit in the PLAYBACK mode, the Q214 side cuts off in the RECORD mode. The DC voltage made by detecting the burst signal in the latter stage is applied to the ACC gain control amplifier for a constant burst signal level. C207 connected to pin 16 is a decoupling capacitor. The ACC output (pin 12) is supplied both to the pilot burst insertion circuit (pin 3 of CX130) and transistor switch circuit Q221.

The chroma signal supplied to the switching circuit goes to the circuit for producing the control DC voltage of the ACC gain control amplifier. Since the Q222 is biased in the PLAYBACK mode, Q222 cut off in the RECORD mode. The 4.43 MHz chroma signal takes two different paths after is passed the Q221. One goes to the APC loop and the other to the 2 H comb filter. The S/N ratio of the 4.43 MHz chroma signal improved by 3 dB. The signal is supplied to the burst gate circuit from pin 6 via the output amplifier. The output amplifier amplifies the chroma signal up to a sufficient level to drive the ACC detect circuit. C226 connected to pin 5 is a decoupling capacitor. A burst gate pulse is applied from pin 22 to the burst gate circuit where the burst signal is extracted. The burst gate pulse is produced by delaying the H. sync in the low pass filter (C272, L210, C273). The extracted burst signal enters the resonance circuit (C219, L202 and T251) from pin 20 to be only the 4.43 MHz portion. The secondary of the burst amplifier transformer (T251) is connected to ground from the viewpoint of AC to obtain two outputs.

One of the outputs is divided by C217 and C218 and enters the detector circuit via the 4.43 MHz CW amplifier from pin 18. The ACC detector circuit processes the 4.43 MHz burst signal for a peak detection and compares the burst signal with the reference signal to obtain an error voltage.

The detected output enters external time constant circuit I from pin 19 and converted to a DC voltage. Q217 is ON and Q218 OFF in the RECORD mode. The time constant circuit is arranged with R215, C212, and C210. The DC voltage filtered in time constant circuit I, goes to R219 from the mid point of T251 and becomes the bias for Q220. The burst signal from T251 is added to Q220 and the resultant voltage enters time constant circuit II. The detected DC voltage goes to the DC amplifier from pins 10 and 11 to control the gain of the ACC gain control. Since this DC voltage corresponds to the input burst level, an ACC loop is formed. When the chroma input is small, the operational DC voltages at pins 10 and 11 decrease so that the ACC amplifier gain becomes larger. The input level is set by changing the pin 17.

The DC voltages from pins 10 and 11 are applied to the colour killer stage to operate the colour killer through the OR gate. The ACC loop is designed so that it works even if the ACC loop locks out. When the ACC loop locks out and the ACC output level lowers approx. 1 dB below the reference, the colour killler operates. The input chroma signal level is 20 dB higher than the colour killer operation level. A hysteresis characteristic is provided for increasing stability around the colour killer operational point. The colour killer output is applied to the pilot burst cleaning circuit IC203 and colour killer functions the pilot burst cleaning circuit at all periode to cut the chroma signal in the B/W mode. The colour killer signal from pin 9 is 4 V in the colour mode and 0 V in the B/W mode. The signal serves for various purposes. The detail will be described in Fig. 3-25.

The 4.43 MHz chroma signal entered the pilot burst insertion circuit (pin 3 of IC202, CX130) from pin 12. The switch circuit (IC202) is a circuit to insert the pilot burst signal. The pilot burst signal produces the 4.43 MHz pilot burst which is phase-locked to the input burst signal. The inserted range is approx. 3 μsec. in the horizontal signal portion and its level is 6 dB higher than the one of the normal one.

The 4.43 MHz chroma signal into which the pilot burst was inserted enters the frequency converter from pin 23 and is low-converted. The frequency converter is arranged with a balanced modulator. When two inputs of fs (4.43 MHz) and fc (A field, 5.119 MHz; B field, 5.123 MHz) are applied to the balanced modulator, the sum of the two frequencies (A, 9.549 MHz; B, 9.553 MHz) and the difference (A, 685 kHz; B, 689 kHz) are obtained as the outputs. If the difference is filtered in a filter, the 4.43 MHz chroma signal is converted to the low range frequency (fc-fs), i.e., 685 kHz for the A field and 689 kHz for the B field. As the signal flow on the schematic diagram, the frequency converter output goes from pin 1 to pin 3, a buffer in IC, pin 4, LPF where it becomes the low-converted chroma signal, and enters amplifier Q225. Q225 works as an amplifier in the colour mode and as a switching circuit to cut off in B/W mode and PB mode. Q226 supplies the 685 kHz and the 689 kHz chroma signals to the record amplifier on the PW2108 as a buffer.

Playback Chroma Process

In the PLAYBACK mode the playback RF signal is supplied to the chroma process circuit from CX134A, RF playback amplifier, on the PW2108. The block diagram and the peripheral circuit of the playback chroma process circuit CX136A are shown in Fig. 3-26. The Y FM signal involved in the playback RF signal is removed in a low pass filter so that the low frequency chroma signals of 685 kHz and 689 kHz are extracted. In the PLAYBACK mode, a voltage is supplied to the Q214 and Q213 side cuts off. The chroma signal enters the ACC gain control amplifier from pin 15. The DC voltage detected the burst signal in the latter stage is applied to the gain control amplifier for a constant burst signal level. Since the hold circuit for the ACC detection output is provided for each of the channels, the ACC loop is independent for each of the A-CH and B-CH so that the difference in the output levels is hardly recognized even if a level difference between the channels is large.

Playback System Chroma Signal Process

The RF switch pulse turns on Q218 of the A-CH and C211 is the capacitor of the time constant circuit I. Q217 is OFF during Q218 is ON and the B-CH potential is held in C210. When the channel is switched, Q217 turns ON and the gain is controlled by the voltage held in C210. Since each channel is independent, the level difference in the outputs is hardly recognized even if there is a level difference in the channel inputs. The level difference in the outputs does not come out because the ACC loop contains a frequency converter, comb filter, and output amplifier.

The operation of the ACC was described in "Record System Chroma Signal Process".
The low frequency range chroma signal is supplied to pin 3 of IC202 from pin 12 after it passes the ACC gain control amplifier and outputted from pin 1 of IC202. Switch IC202 is connected to the pin 3 side in the PLAYBACK mode. The low frequency range chroma signal applied to pin 23 is low-converted by the converting carrier from pin 24 in the IC and outputted from pin 1. The signal from pin 1 goes through buffer (input . . . pin 3 and output . . . pin 4) and then to the bandpass filter. Thus the 4.43 MHz chroma signal is obtained.
The frequency converter input to pin 23 is the (44 - 1/8) fH = 685 kHz in the A field and the (44 +1/8) fH = 689 kHz in the B field. The conversion carrier to pin 24 is the 4.43 MHz + (44 -1/8) fH = 5.119 MHz for the A field and the 4.43 MHz + (44 +1/8) fH = 5.123 MHz for the B field. The frequencies are supplied in synchronization in each field and processed for the balanced modulation. Then the sum of the frequencies, 4.43 MHz + 2 (44 ±1/8) fH, and the difference, 4.43 MHz, are obtained as the outputs as well as in the RECORD mode. Only the 4.43 MHz component can be extracted from these signals with the help of the bandpass filter. Since the output frequency and the carrier frequency are close in the frequency conversion and a carrier leak is caused when the converter balance is poor, R252 is provided for the balance adjustment.

The 4.43 MHz chroma signal passes the switch circuit consisting of Q222, is amplified in Q223, and enters the comb filter. In the PLAYBACK mode, Q221 is OFF.
The playback chroma signal contains the crosstalk component from the adjacent tracks due to the overlap recording and the crosstalk component is eliminated in the comb filter.
The subtraction of the 2 H delay line output and the non-delayed signal in the comb filter. Since both the signals flow through R238 and the 4.43 MHz chroma signal flows in the same direction as shown in the figure, the output is doubled. As the crosstalk component flows in the opposite direction and is cancelled, the output becomes zero. The chroma signal whose crosstalk component was removed is amplified in Q224 and supplied to the output amplifier (pin 6 of IC201). The insertion loss in the delay line is amplified in Q223 and Q224 so the signal levels of the Q223 base and the Q224 collector are almost equal.
The signal supplied to pin 6 of IC201 takes two paths. One goes to the burst gate to be the ACC control voltage as described previously and the other takes two different paths. One passes the 1 H delay line (IC204) in the STILL mode and enters the Y/C mix circuit. The other goes to the carrier signal phase inversion and the burst ID circuits.

[AFC and APC Circuits] CX137A
IC206, CX137 is used as an AFC system IC and IC207, CX137 as an APC system IC.

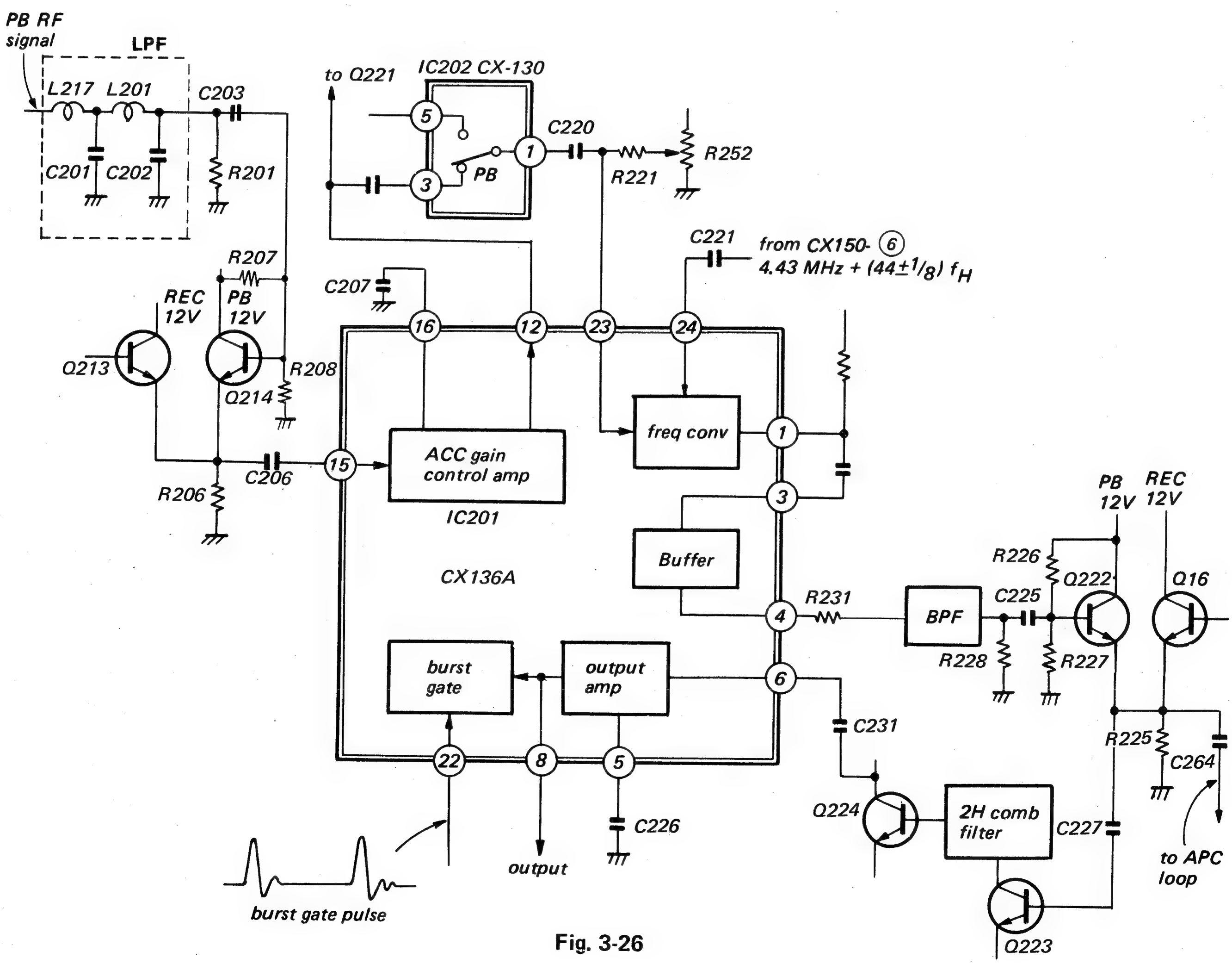


Fig. 3-26

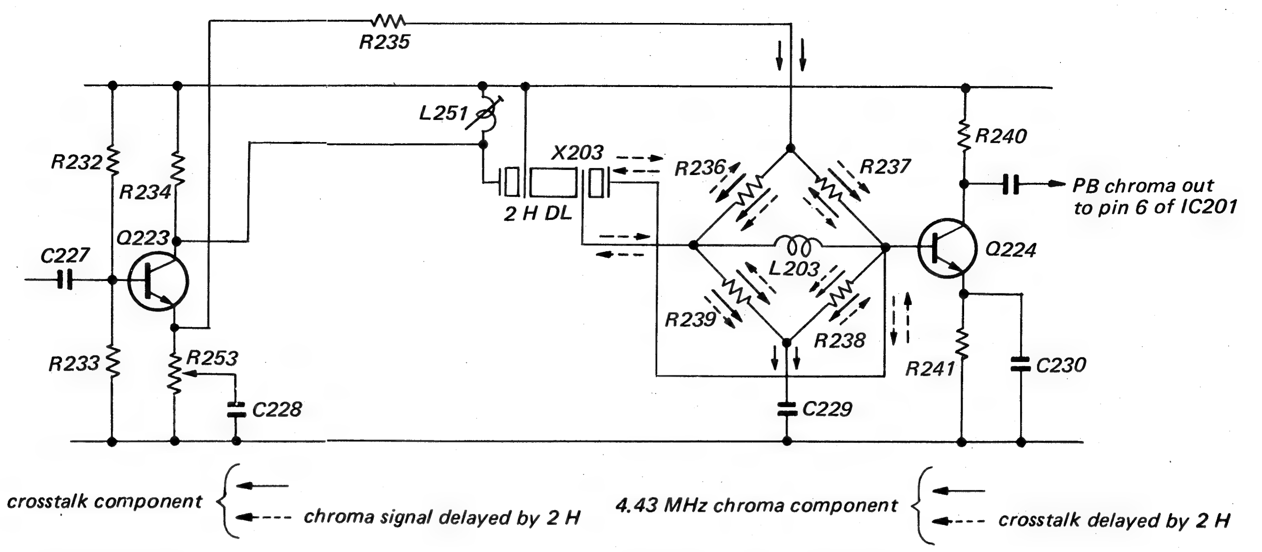


Fig. 3-27

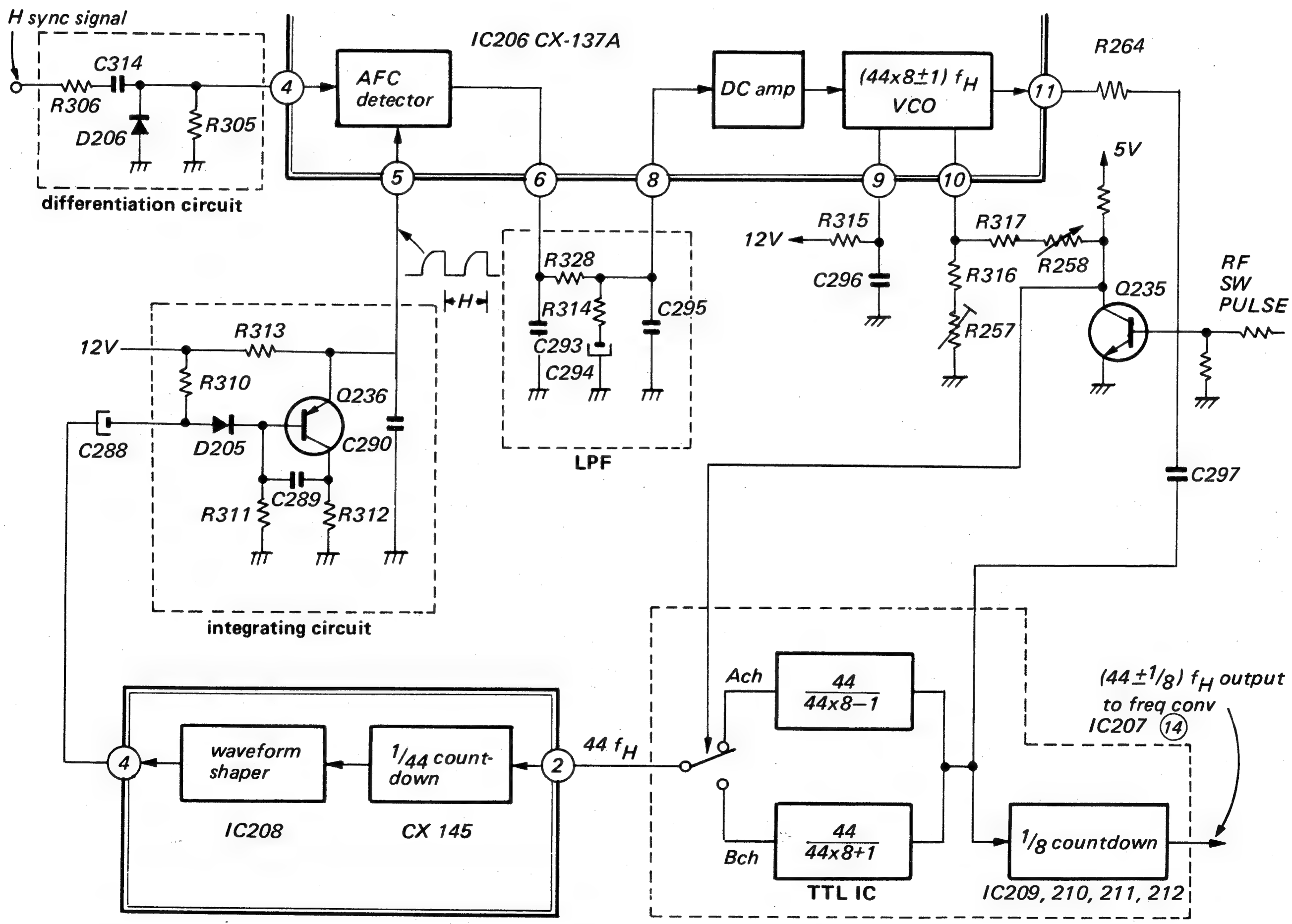


Fig. 3-28

AFC Circuit

The AFC circuit divides the signal, which is made by multiplying the H. sync signal by (44 x 8 ± 1) in both the record and playback, into 8, obtaining the CW signals of 685 kHz = (44 - 1/8) fH and 689 kHz = (44 + 1/8) fH. The PLL (=Phase Locked Loop) is utilized for the (44 x 8 ± 1) multiplication and it is called AFC in relation to the TV receiver because the H. sync signal is used.

The AFC circuit is shown in Fig. 3-28. The $\frac{44}{44 \times 8 \pm 1}$ counting down circuit in the AFC loop comprises TTL, IC209, IC210, IC211 and IC212.

The 1/44 counting down circuit is contained in IC208, CX145.

The waveform of each section is shown in Fig. 3-29.

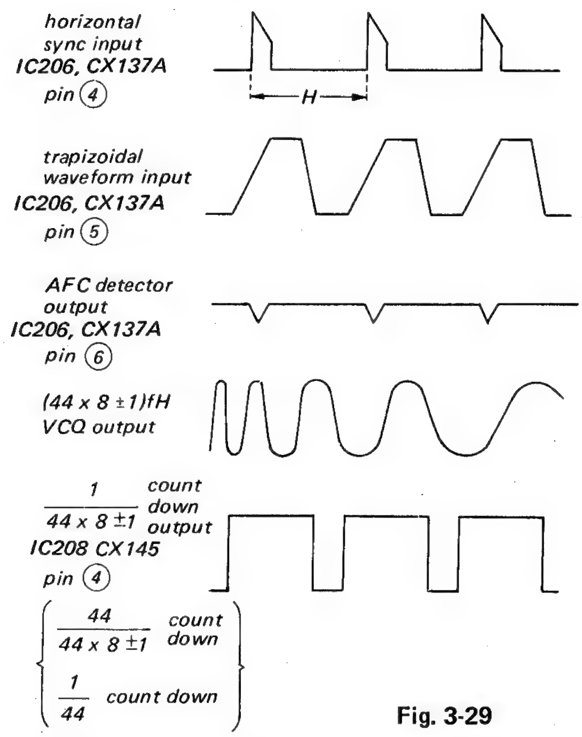


Fig. 3-29

The AFC detection circuit is a sampling hold circuit. It samples the trapezoidal waveform applied to pin 5 with the H. sync pulse applied to pin 4 for the phase detection. The detected output goes the low pass filter (consisting of C293, C294, C295, R328, R314) from pin 6 and enters the DC amplifier from pin 8. The DC amplifier output controls the oscillating frequency of VCO (= Voltage Controlled Oscillator) to obtain the (44 x 8 ± 1) oscillating output. The oscillating circuit is a multivibrator oscillator arranged with C and R. The oscillating frequency is determined by R315 and C296 connected pin 9. The discharge current of the multivibrator is varied with R257 for controlling the oscillating frequency. The frequency is (44 x 8 - 1) fH in the A-CH and (44 x 8 + 1) fH in the B-CH. Since the oscillating frequencies are different between the channels, a difference is produced in the AFC detection output. The difference is corrected with R258 so that the AFC lock points for the A-CH and B-CH position at the center of the slope of the trapezoidal wave form.

The oscillated frequency is divided into $\frac{44}{44 \times 8 - 1}$ in the A-CH and $\frac{44}{44 \times 8 + 1}$ in the B-CH in the counter circuit of TTL which will be described later. Thus the 44 fH outputs for the A- and B-CH are obtained. The outputs are supplied to pin 2 of CX145, IC208. The 44 fH is divided by 1/44 to obtain a signal of fH frequency in CX145. Since the counted down output is a rectangular wave form, it is wave-shaped in the Q236 and the peripheral CR circuit to a trapezoidal wave form and supplied to the AFC detection circuit in IC206, CX137A. The (44 x 8 ± 1) fH VCO output synchronizing with the H. sync frequency is obtained in the AFC loop explained above. The VCO output is counted down to 1/8 in IC212 to be (44 ± 1/8 fH, converted to the sum frequency with 4.433619 MHz crystal oscillator output, and supplied to the chroma signal frequency converter circuit.

[APC Circuit] CX137A

The APC (= Automatic Phase Control) operation is different a little in the record and the playback. It is switched by the external circuit. The block diagram of the APC is shown in Fig. 3-30.

The APC circuit comprises the phase detector circuit, reactance circuit, 4.43 MHz variable crystal oscillator (hereinafter called "VXO"), burst gate circuit, and 4.43 MHz crystal oscillator circuit oscillating the reference phase. The frequency converter to supply the carrier signal to the chroma signal frequency converter circuit is included in IC207, CX137A. The reactance circuit is a variable capacitance type and connected to the 4.43 MHz variable crystal oscillator as the oscillation constant. The phase detector is connected to the reactance circuit which produces the 4.43 MHz VXO output whose frequency is controlled by the phase detector output. The VXO output is fed to the frequency converter where it is added to the (44 ±1/8) fH VCO output and converted to a frequency of 4.43 MHz + (44 ±1/8) fH. This output passes the band pass filter (Z203) from pin 15 and is supplied to the chroma frequency converter (CX136A) for the record and the playback via CX150.

The 4.43 MHz input chroma signal is supplied to the APC detection circuit in the RECORD mode as the reference signal from pin 21.

The 4.43 MHz VXO output is supplied to pin 23 via Q239 as a comparison signal. (The Q238 and Q239 circuit forms the switch circuit of the REC/PB. Q239 operates in the RECORD mode and Q238 in the PLAYBACK mode.) The phase of the 4.43 MHz VXO output is compared with the one of the reference signal, the burst of the 4.43 MHz VXO output. The detected output is filtered in the CR filter connected to pins 20 and 22 and supplied to the VXO where the 4.43 MHz frequency is controlled. The phase-locked 4.43 MHz is supplied to the pilot burst insertion circuit via the phase shifter (consisting of L213, C300, C299). Since the phase comparison is performed with the burst signal, the operation of the phase detection circuit is controlled with the burst gate circuit so that the APC phase detector output appears only in the burst period. A burst gate pulse is produced by delaying the horizontal sync in the delay circuit (L210, C273, C272). In the RECORD mode the gate pulse on the D203 side is supplied to pin 24.

In the PLAYBACK mode the PB 4.43 MHz chroma signal is supplied to the phase detector circuit from pin 21. The reference signal is supplied from the 4.43 MHz crystal oscillator arranged between pins 19 and 23. (Q238 is ON and Q239 OFF.) The burst of the 4.43 MHz chroma signal is compared with the phase of the reference 4.43 MHz.

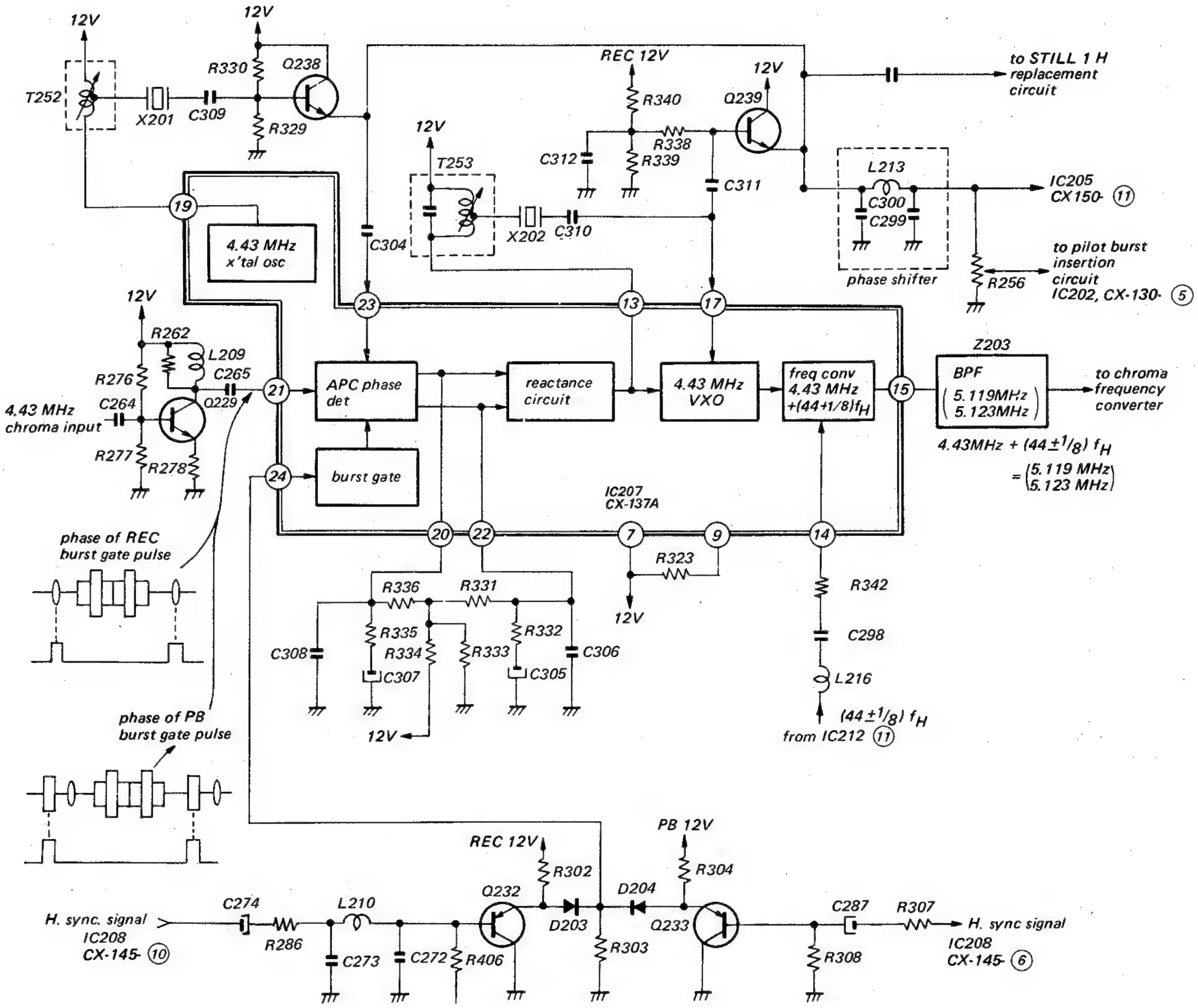


Fig. 3-30

This detected output is filtered as well as in the RECORD mode and supplied to the VXO. The burst gate pulse in the PLAY mode is supplied to pin 24 from the D204 side with the timing of the gating the pilot burst signal inserted into the horizontal period in the RECORD mode.

The APC function can be summarized as follows. The APC circuit produces the phase-locked 4.43 MHz signal for the pilot burst in the RECORD mode and removes the phase variation component caused by jitters in the PLAY mode, obtaining the 4.43 MHz chroma signal having phase stability.

[1/44 Countdown and Sync Separator] CX145

IC208, CX145 contains the sync separator, the horizontal pulse generator, the 1/44 countdown, and other circuits. It serves as a part of the AFC loop previously described. The block diagram of the CX145 is shown in Fig. 3-31.

The direct E-E video signal in the RECORD mode or the PB video signal in the PLAYBACK mode is supplied to that pin 13 from the TA7636P. The video signal supplied to pin 13 is applied to the sync separator and a composite sync output appears at pin 10. C and R circuit connected to pin 11 is the clamp time constant circuit for the sync separator circuit. The MMV1 is triggered with the composite sync output to remove the equivalent pulse in the vertical blanking period, extracting a horizontal pulse. C and R circuit connected to pin 9 is the time constant circuit for the monomultivibrator. The MMV1 output triggers the MMV2 to shape the signal wave form into a horizontal pulse with a constant pulse width. The C and R circuit connected to pin 7 is the MMV2 time constant circuit.

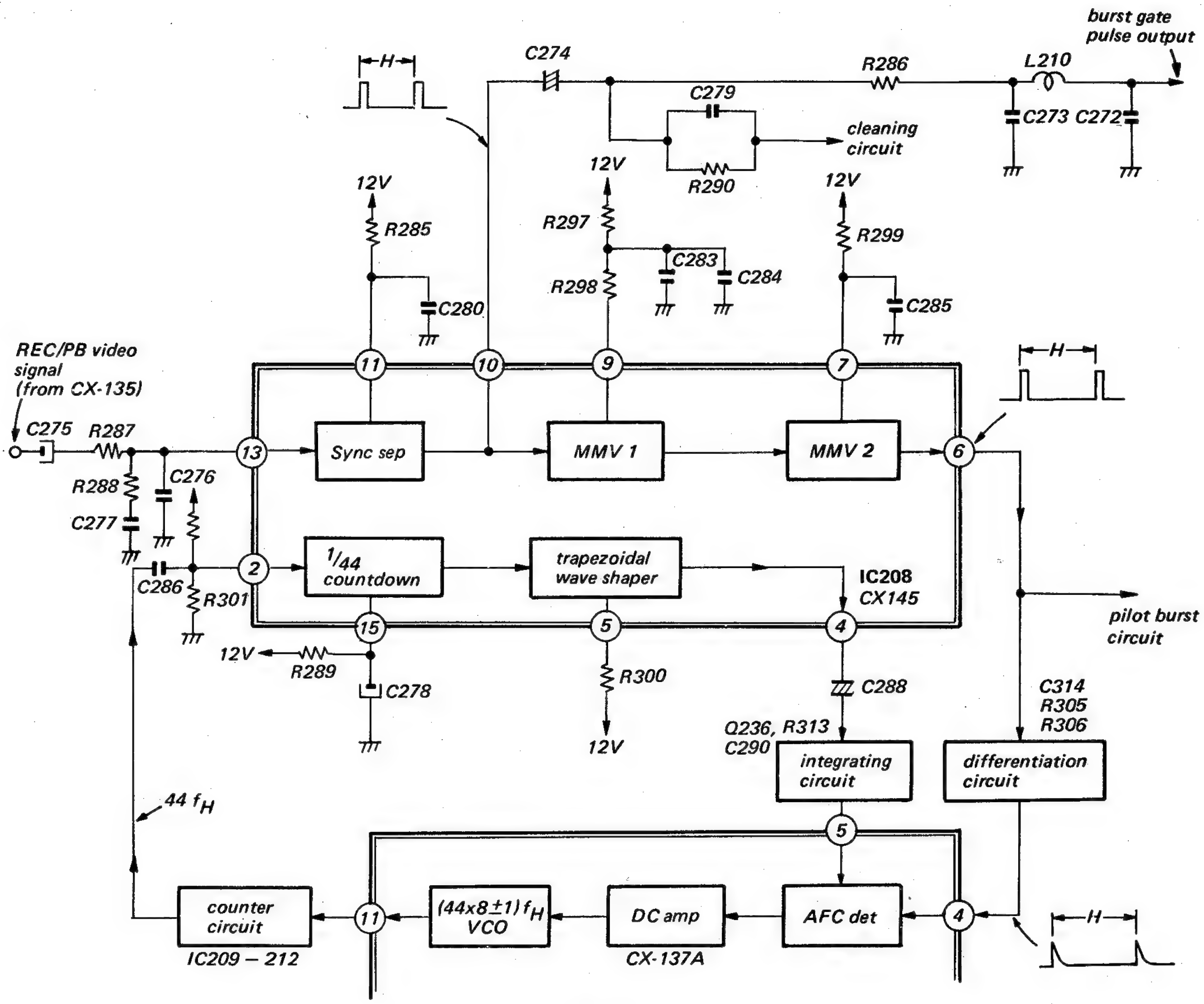


Fig. 3-31

The horizontal pulse output at pin 6 is supplied to the AFC in the CX137A and to the pilot burst in sertion circuit in the CX150. A sample of the horizontal pulse becomes a pilot burst gate pulse. The horizontal pulse output from pin 10 goes through the delay circuit consisting of C273, C272, and L210 to be the burst gate pulse and a part of the output becomes a cleaning pulse. The horizontal pulse applied to pin 4 of CX137A serves at the sampling gate signal of the AFC detecting circuit.

The 44 fH counter output of the AFC loop is applied from pin 2 to the 1/44 countdown circuit where it is divided by 44 into the fH rectangular wave. Since the counted-down output from pin 4 is the rectangular wave, it is processed in the integrating circuit for a trapezoidal wave form shaping and supplied to the AFC detector circuit in the CX137A.

[$\frac{44}{44 \times 8 \pm 1}$ Countdown Circuit] SN74LS93N x 2, SN 74LS00N, SN74LS74N

The $\frac{44}{44 \times 8 \pm 1}$ countdown circuit contained in the AFC loop divides the $(44 \times 8 \pm 1)$ fH into 44 fH to supply the 44 fH to the 1/44 countdown circuit in the CX145 and produces the signal for the $(44 \pm 1/8)$ fH chroma conversion carrier. The schematic diagram is shown in Fig. 3-32 and the time chart in Figs. 3-33, 3-34.

The following description is the case that the RF switching pulse is the A channel. The $(44 \times 8 - 1)$ fH oscillating output from the VCO (at pin 11 of IC206, CX137A) is amplified in IC209 #3, and applied to pin 1 of IC210, SN74LS93N. The integrated circuit is a TTL IC for the binary and octal counters. The octal counter output appears at pin 11 of IC210. The IC209 #3 wave form of $(44 \times 8 - 1)$ fH represented by (1) in Fig. 3-33 is divided by 8 and appears at pin 11 in the wave form (4) in the time chart. The output

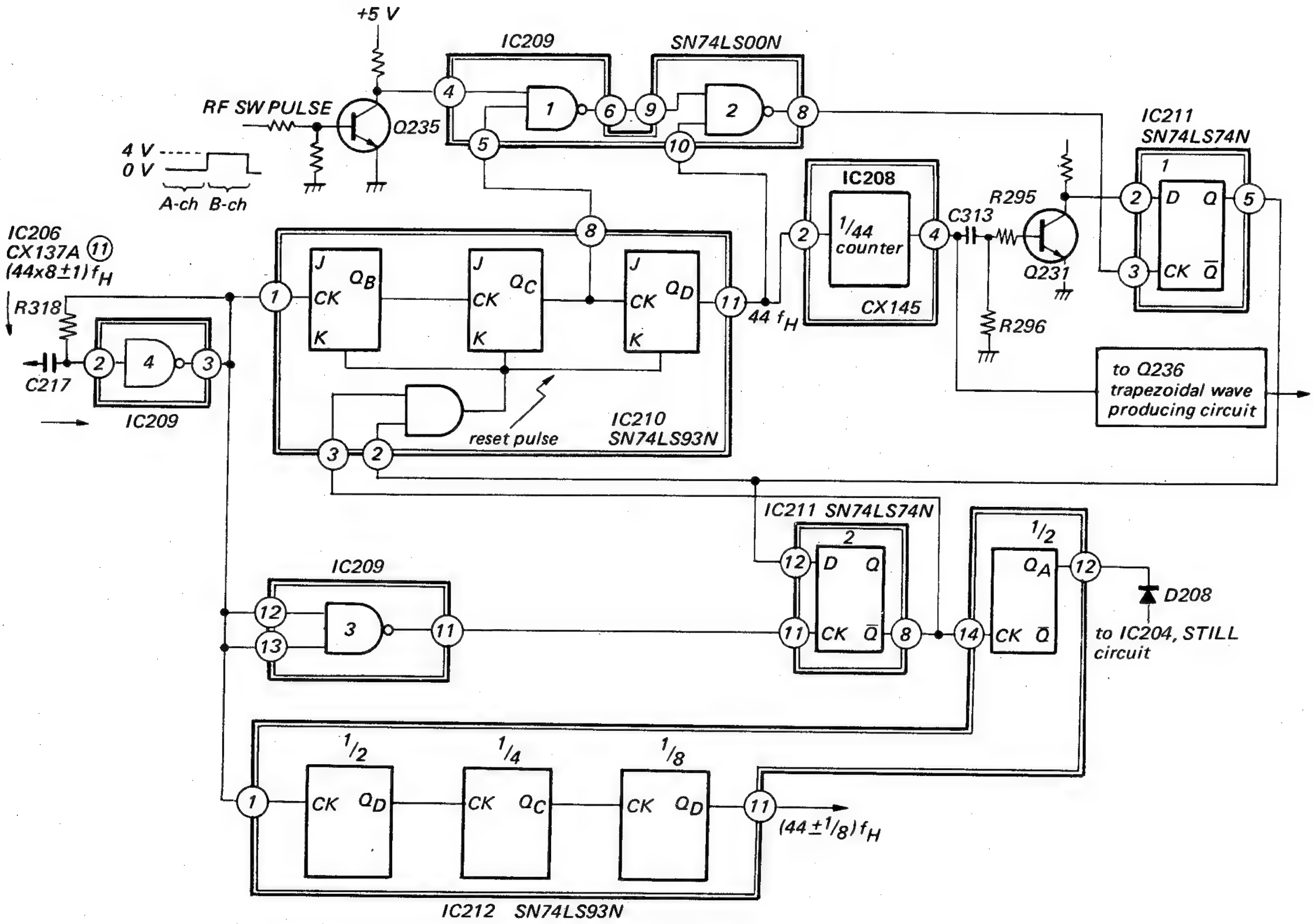


Fig. 3-32

from pin 11 of IC210 is counted down to 1/44 in the CX145. When the 1/44 counted-down pulse rises at Point E in Fig. 3-33, the wave form at pin 4 of IC208 becomes as shown in (5) and differentiated in the C313, R296 circuit. The differentiated wave from at the Q231 base is shown in (6) and the wave form at Q231 collector in (7). This signal acts as the data input to IC211, SN74LS74N. Since the RF switching pulse is 0 V in the A channel, the Q235 collector is 5 V and NAND gate 1 operates with the inputs from pin 5. In this case the gate 1 works as INVERTER for (3) the 1/4 counted-down output from pin 8 of IC210. The output of the NAND gate (8) appears at pin 6 of IC209. Similarly NAND gate 2 of IC211 is the NAND gate for (8) and (4) wave forms in the time chart. Its output (9) appears at pin 8 of IC209 and supplied to flip-flop 1 of IC211 as the clock signal. Since the data input is Q236 collector wave form (7), the flip-flop output appears at pin 5 of IC211 in the wave form represented by (10). Wave form (10) enters pin 12 of IC211 as the data input for flip-flop 2. The IC209 pin 3 output is inverted in the NAND gate 3 in IC209 and outputted from pin 11. The output wave form shown in (12) works as the clock pulse for flip-flop 2 of IC211. The D flip-flop output of IC211 shown in (13) appears at pin 8 of IC211. The two pulses (10) and (13) thus produced in the above process enter the internal NAND gate in IC210 from pins 2 and 3 of IC210. The NAND gate output (14) serves as the reset pulse of the counter circuits in IC210. The reset pulse (in the Ⓖ to Ⓒ segment in the time chart) clears all the counters and the relationship of 1/2, 1/4, and 1/8 among the wave forms is varied only in the Ⓑ to Ⓒ segment. For example, there are 7 wave forms of wave form (1) for 1 cycle of wave form (4) in the Ⓑ to Ⓒ segment but 8 wave forms in other segments such as Ⓐ to Ⓑ and Ⓒ to Ⓓ.

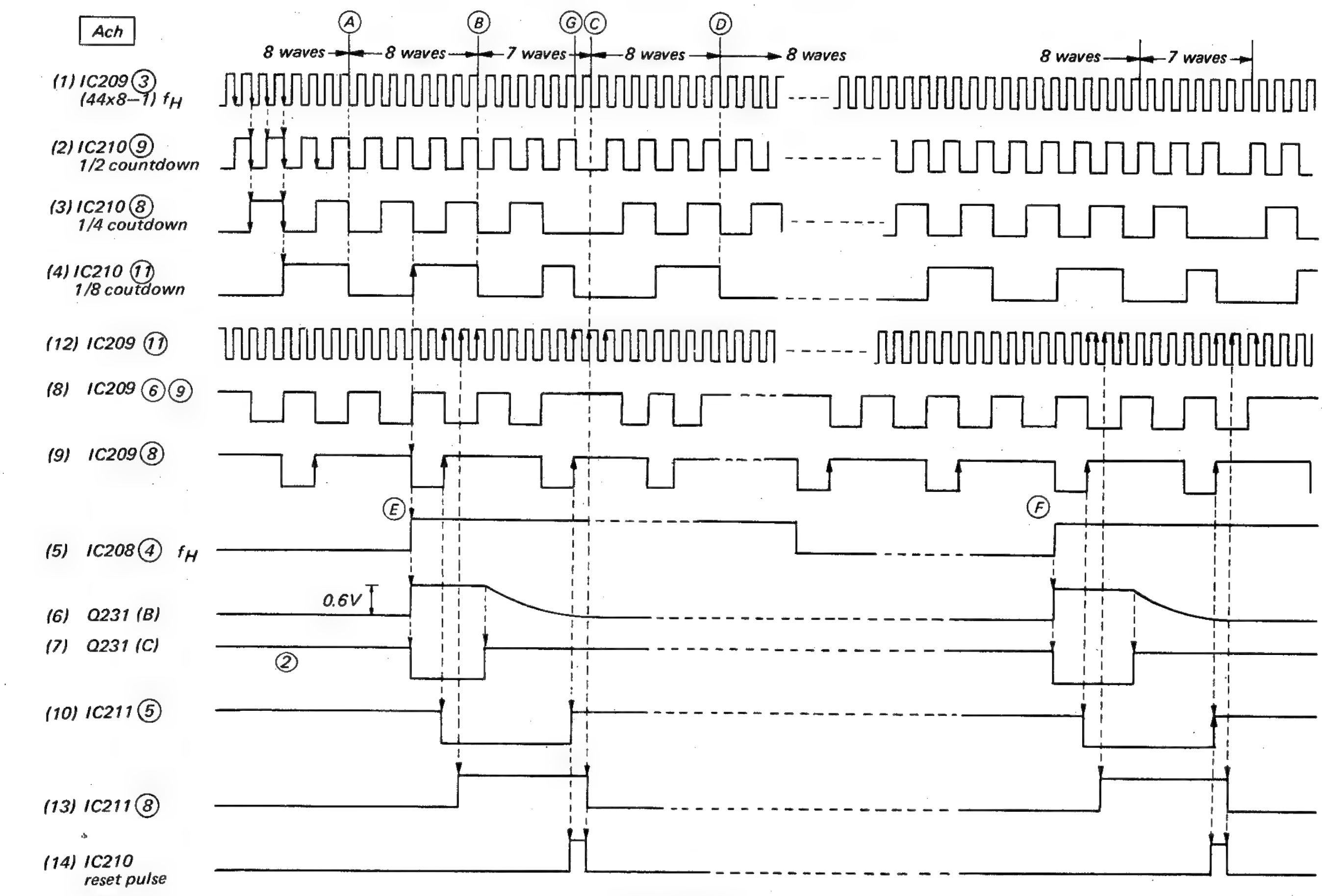


Fig. 3-33

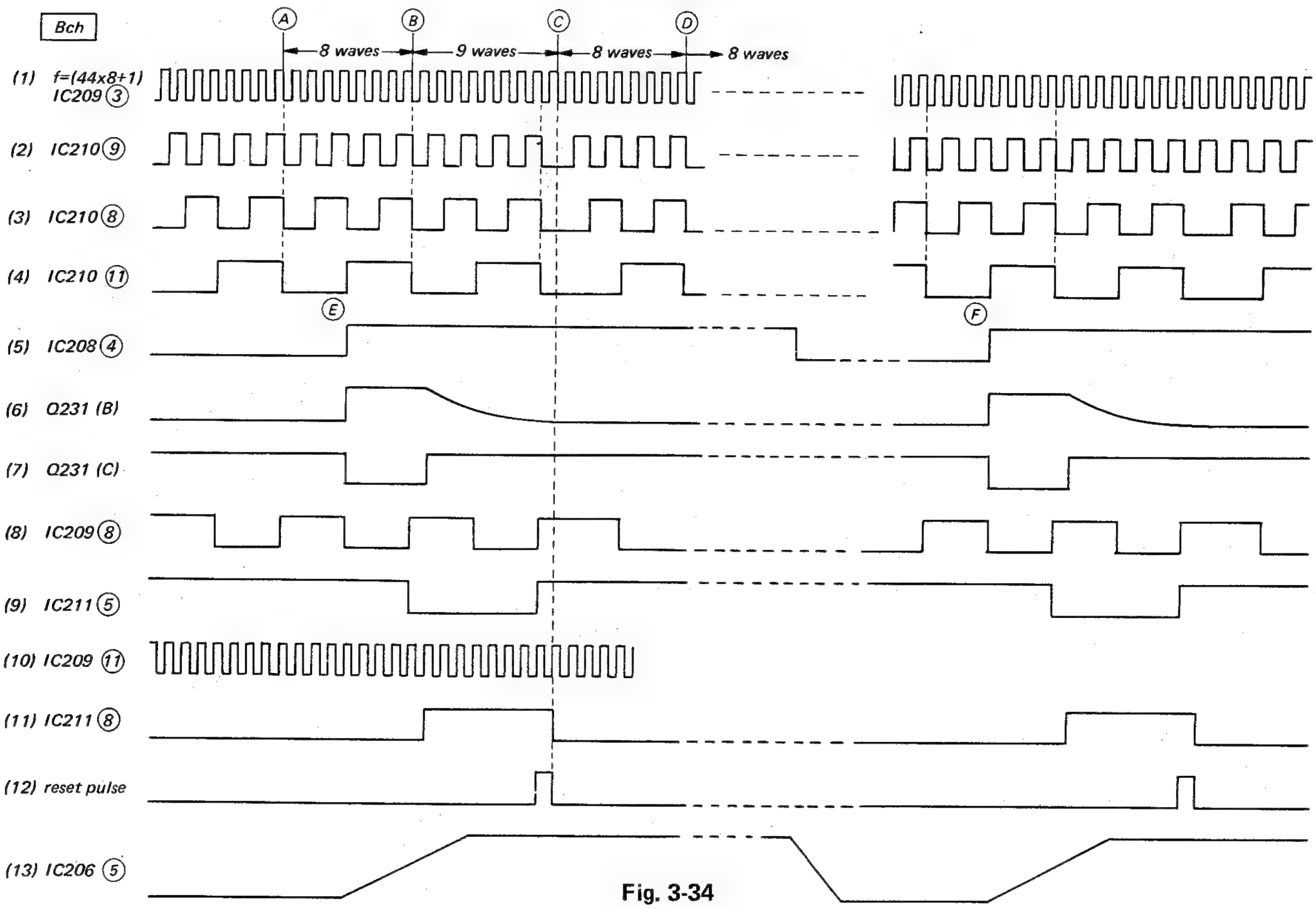


Fig. 3-34

Since wave form (4) processed for 1/44 countdown is wave form (5), the number of wave form (1) existing in 1 cycle of wave form (5) [Ⓔ to Ⓕ in the time chart] is;

$$\underbrace{8+8+\ldots+8+(8-1)}_{44} = 8 \times 44 - 1$$

Thus wave form (5) is counted down into $\dfrac{1}{44 \times 8 - 1}$.

The output frequency of the VCO is (44 x 8 - 1) fH and pin 4 of CX145, IC208, becomes (44 x 8 - 1) fH x $\dfrac{1}{44 \times 8 - 1}$ = fH.

The operation of the B channel is as follows. Since RF switching pulse is approx. 4 V, Q235 conducts and pin 6, output of NAND gate 1 in IC209, becomes 5 V, the wave form at pin 8 of the NAND gate 2 output is the one represented by (8) which is the inverted one of the wave form at pin 11 of IC210. The following operation is identical with the one in the A channel. The reset pulse of IC208 is represented by (12) in Fig. 3-34 and the number of wave form (1) in the Ⓑ to Ⓒ segment is 9 and in the other segments it is 8.

$$\underbrace{8+8+\ldots+8+(8+1)}_{44} = 8 \times 44 + 1$$

Since the output frequency of the VCO is (44 x 8 + 1) fH, the frequency at pin 4 of IC208, CX145, is;

$$(44 \times 8 + 1)\ \text{fH} \times \frac{1}{44 \times 8 + 1} = \text{fH}$$

As previously stated, wave-form (5) passes the integrating circuit to become trapezoidal waveform (13). The waveform serves as the trapezoidal waveform input to the AFC detector circuit.

[Carrier Signal Phase Inversion and Burst ID Circuit] CX150

IC205, CX150, is arranged with the carrier signal phase inversion circuit and the burst ID circuit. Its block diagram is shown in Fig. 3-35.

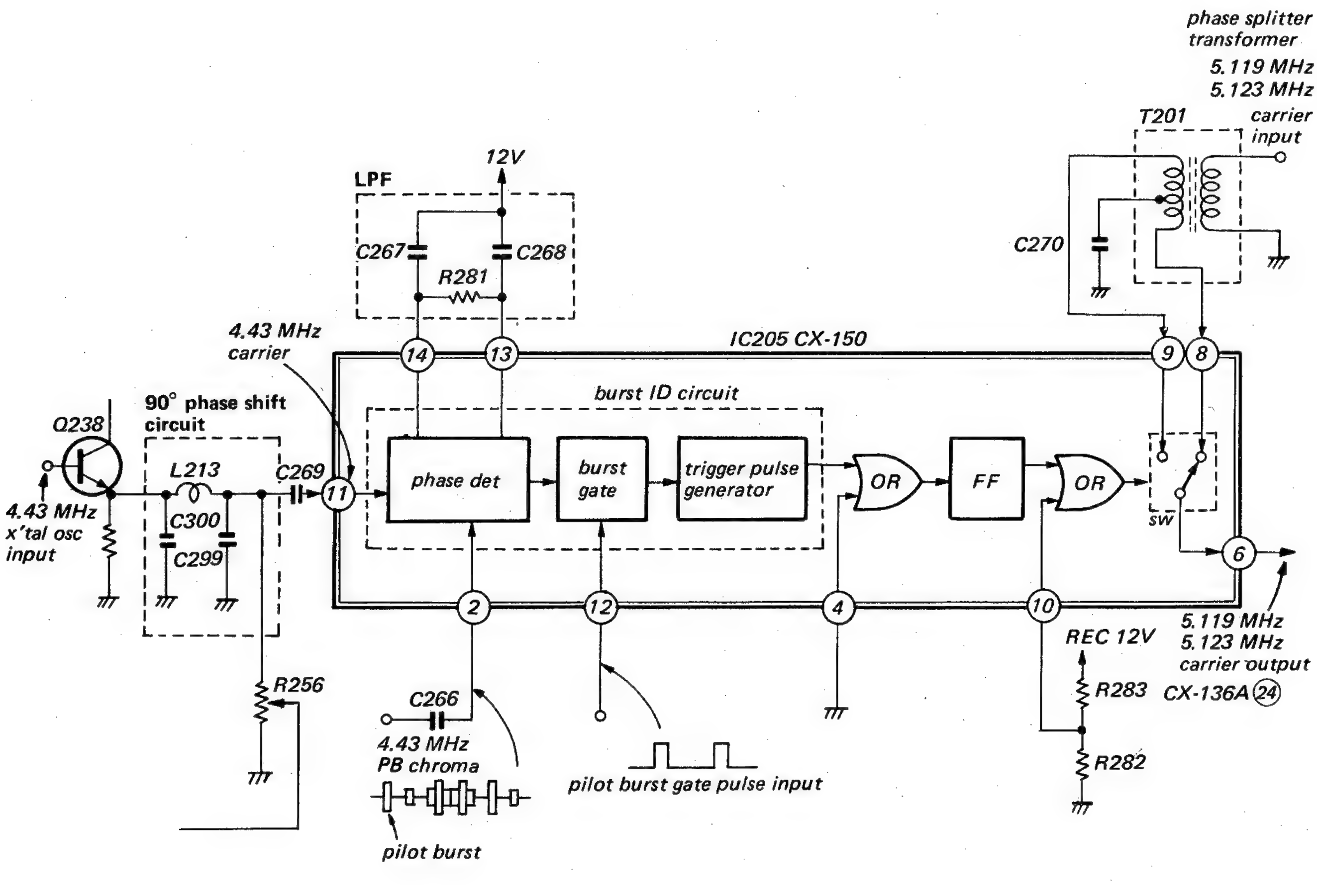


Fig. 3-35

The carrier phase inversion circuit is arranged with a flip-flop and a switching circuit. The 5.119 MHz or the 5.123 MHz carrier signal supplied from CX137A is phase-split in T201, phase splitting transformer. The phase split output from the secondary of T201 is supplied to the switching circuit via pins 8 and 9. The positive phase of the 5.119 ≒ 4.43 MHz + (44 - 1/8) fH or the 5.123 MHz ≑ 4.43 MHz + (44 + 1/8) fH carrier is applied to pin 8 and its negative phase to pin 9.

The output of this switching circuit (at pin 6) is supplied to the record and the playback chroma frequency conversion circuits. In the RECORD mode, the switching circuit is connected to the pin 8 side by setting pin 10 to the high level. In the PLAYBACK mode, the switching circuit is switched with the flip-flop output passed the OR gate. Sometimes the switching circuit operates reversely at a 50% probability, inverting the phase of the chroma signal when the trigger input of the flip-flop becomes disorder in the dropout section or depending on the ON-OFF states of the flip-flop when the PLAYBACK mode is set up. The burst ID circuit is for prevention of the reverse operation of the switching circuit. The burst ID circuit is an orientation circuit to supply the trigger pulse to the flip-flop when the switch phase becomes reverse and to restore the phase.

The orientation circuit compares the phase of the 4.43 MHz crystal oscillator output which is the reference signal in the PLAYBACK mode with that of the pilot burst signal of the 4.43 MHz chroma signal. A trigger pulse is obtained when the phase is inverted 180° and applied to the flip-flop via the OR circuit. Generally the relative phase difference between the pilot burst signal of the 4.43 MHz chroma signal and the reference 4.43 MHz crystal oscillator output is 90° when the APC is locked. Therefore the reference 4.43 MHz signal is fed through the 90° phase circuit to make the signal in phase with the pilot burst signal of the normal chroma signal before the phase comparison.

C and R circuit between pins 13 and 14 in the phase detector circuit is the filter for the detected output. The filtered output is applied to the burst gate which gates the burst period in the phase detector output. The trigger pulse producing circuit compares the internal reference voltage with the detected output voltage, detects a difference between the reference voltage and the detected output voltage in case of the 180° phase shift of the chroma signal, and produces the trigger pulse.

[1 H Delay Circuit]

IC204, CX150, functions for a chroma signal stabilization in the STILL mode. The fundamental operation of IC204 is arranged with a phase inverter circuit and a burst ID circuit as well as IC205, CX150.

The R-Y and the B-Y signals are repeated every line in the PAL chroma signal. The 1 H delay circuit detects a repetition disorder due to noises or others in the STILL mode and replaces the disorder with a 1 H delayed chroma signal to provide a stable color picture. The block diagram of the 1 H delay circuit is shown in Fig. 3-36.

The 4.43 MHz crystal oscillator output is supplied to pin 11 as the reference input for the phase detection. The 4.43 MHz chroma signal is supplied from pin 2 as the comparison input. Since the 4.43 MHz chroma signal is a repetition signal of the R-Y and the B-Y signals, a color continuity can be judged by gating the burst every other 2 H. See Fig. 3-37.

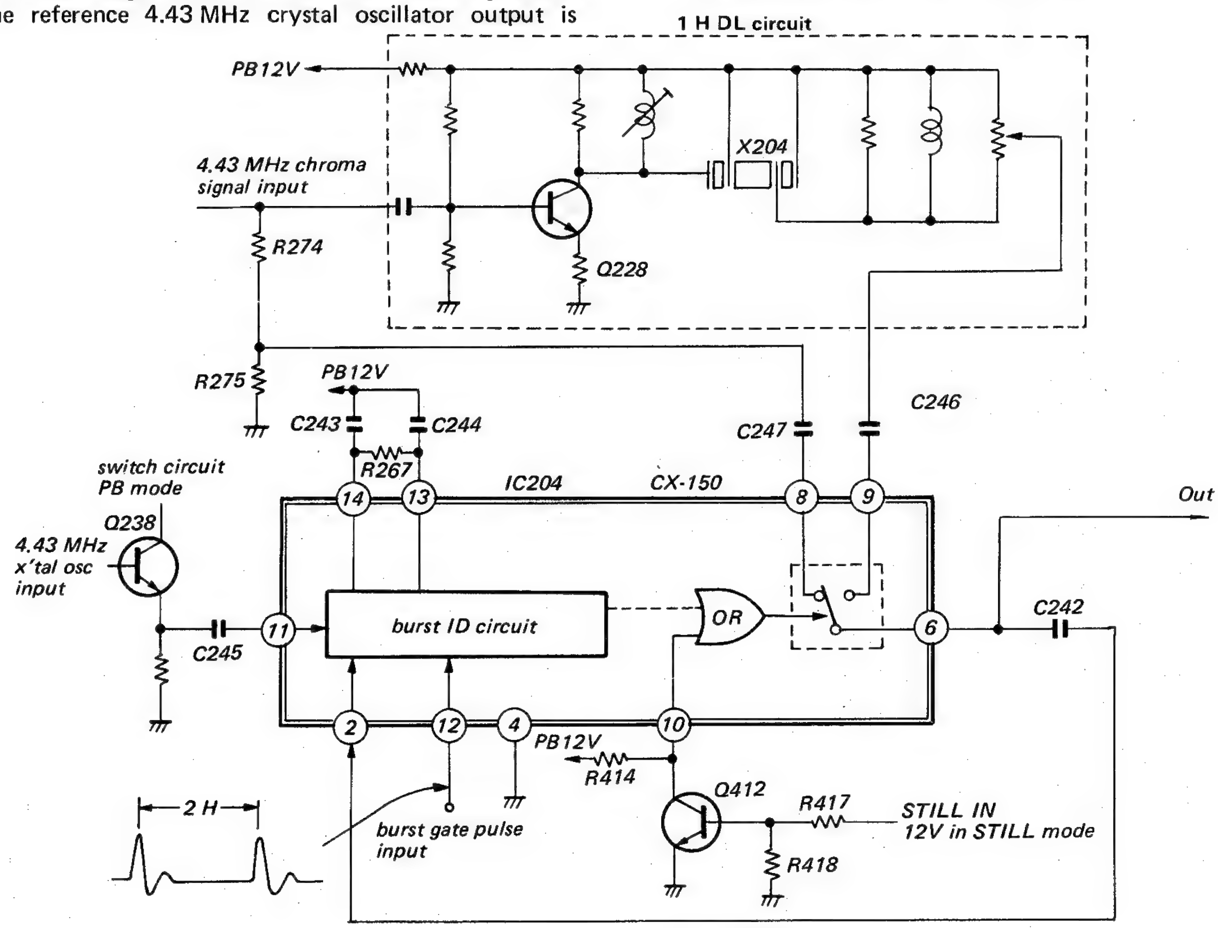


Fig. 3-36

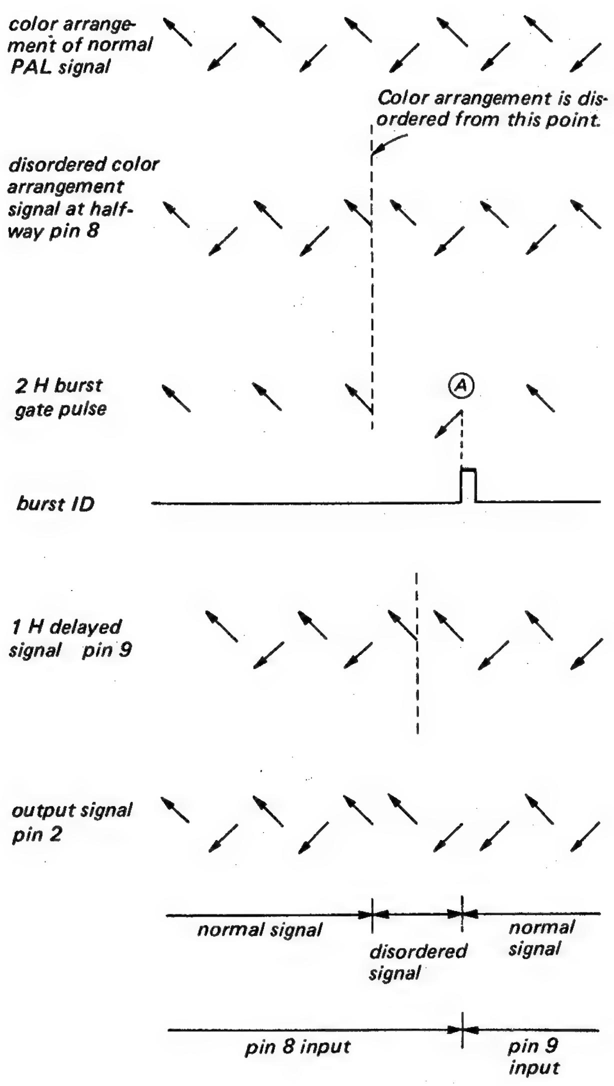


Fig. 3-37

When the chroma signal whose colour arrangement is placed into disorder at halfway is detected in the signal system, the phase of the 2 H burst gated burst signal is disordered largely at point A.
The burst ID pulse is produced when the disorder is detected. The burst ID pulse inverts the flip-flop, operating the switching circuit so that the input is switched to pin 9 from pin 8. Thus the 1 H delayed signal replaced with and the normal colour arrangement signal is restored.
Since the MUTE IN is 12 V in the STILL mode, Q412 turns on, and pin 10 turns to 0 V, the switching circuit operates only in this condition. In other modes the switch is connected to the 8 pin side.

[ID Cleaning Circuit] CX130
IC203, CX130 is a switching integrated circuit. See Fig. 3-38.

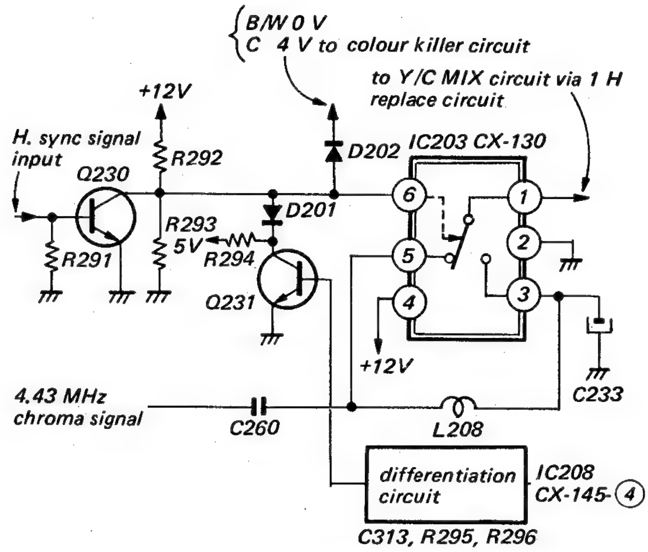


Fig. 3-38

The cleaning circuit functions for the cleaning of the sync signal segment which the pilot burst signal is inserted in and the one of the noises from the color circuit in the B/W mode.
L208 makes the DC potentials of the switching circuit, i.e., the inputs to pins 3 and 5, identical for prevention of switching noises. C233 is the capacitor for the input shorting.
The cleaning pulse phase is shown in Fig. 3-39.

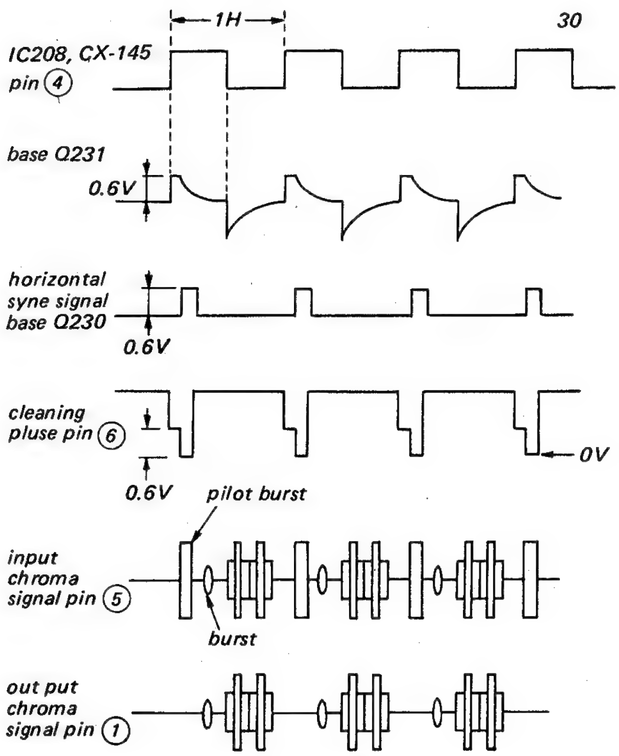


Fig. 3-39

Since the phase of the rectangular wave at pin 4 of IC208, CX145, is before the H. sync signal, the cleaning pulse produced in Q231 and Q230 starts in advance of the H. sync signal and performs the cleaning of the horizontal blanking segment with the pilot burst.

3-3. SERVO SYSTEM

3-3-1. General

The V5470 has both Head servo circuit and capstan servo circuit employed. The head disc is driven with use of a brushless DD (direct drive) motor. The capstan and reels are revolved by a coreless motor. As the reference signal, the signal of a 5.97 MHz crystal-controlled oscillator, which is frequency-counted down, provides stable servo control. The servo circuits are built on PW2110. As the servo IC is used TM-4216P (NMOS IC) labeled IC501, which contains a disc control APC, a capstan AFC and APC, and other signal processing circuits. In addition, IC502, and IC503 are used for impedance conversion and amplification as IC501 is NMOS IC. The servo circuits are broadly classified into four circuits:

(1) Servo peripheral circuit
(2) Head servo circuit
(3) Disk drive circuit
(4) Capstan drive circuit

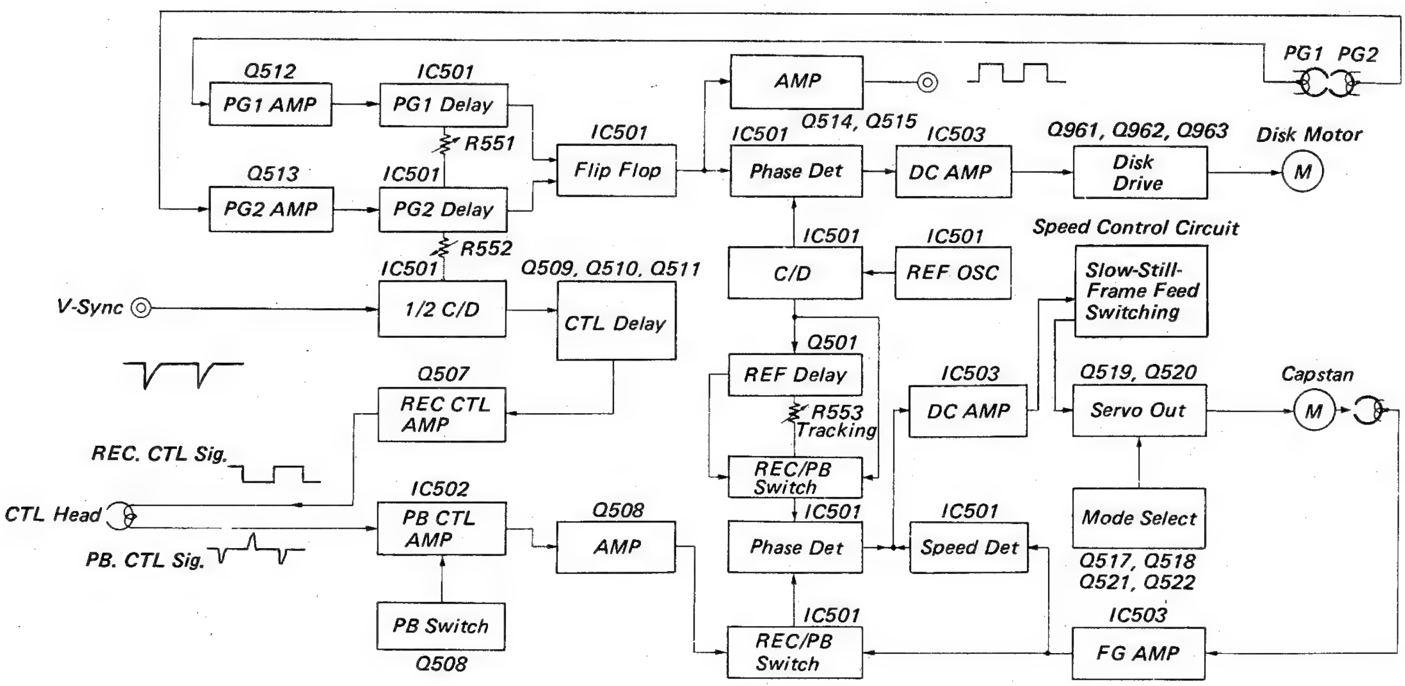


Fig. 3-40 Servo Block Diagram

3-3-2. Servo Peripheral Circuit

In the recording mode, the vertical sync pulses separated by Q632 on the Video Circuit board PW2109 enter through the integrating network, consisting of R670, R671, C638 and C639. The integrating circuit passes the vertical sync pulses, which is applied to Q633 and D630, on the Servo and Logic Circuit board PW2110.

The amplified vertical sync pulse at pin 27 is shaped to 25 Hz square wave by the ½ countdown circuit. The 25 Hz square wave is recorded as the control pulse through the control head onto tape as described below in detail.

The 25 Hz square wave is fed from pin 26 of IC501 to the monostable multivibrator, consisting of Q509, Q510, and Q511. The monostable multivibrator serves for "auto-find (program start location)", which is newly provided in the V-5470B. Refer to Fig. 3-46. The auto-find feature is capable of detecting the difference between the playback tape speed and rewinding or fast-forward tape speed. It, also, detects the difference between the control pulse duty cycle of the recording start portion and the steady-state portion (after 25 sec or more). In recording, Q509, Q510, and Q511 make the duty cycle difference of the state portion from the steady-state portion. In the state before the RECORD button is depressed, Q509 and Q511 are in the "on" state, with a short time constant determined in terms of R519 and R520 in parallel and C509. The 25 Hz signal from pin 26 of IC501 is differentiated through C510 and R523.

If the RECORD button is depressed, then D501 is turned off as the recording 12 V voltage is applied to its cathode. The base current of Q511 flows so as to allow C508 to charge. As C508 charges, the base current of Q511 tends to decrease; that is, the internal resistance of Q511 increase. The result is that the time constant is made longer. This changes the duty cycle of the control pulse at the recording start portion. In the steady-state 25 sec after the RECORD button was depressed, C508 charges further. This prevents the base current in Q511, which is turned off. Then, the MMV is inverted by negative pulse from pin 26 of IC501 duty input pulse. (Fig. 3-45.)

5 V Power Source

The 5 V power source is provided for use with IC501. This power voltage is produced in the manner that the regulated 12 V power from the Power Supply Circuit board PW2111 is further regulated to 5 V by Q523 and zener diode D505, and R583.
Refer to Fig. 3-41.

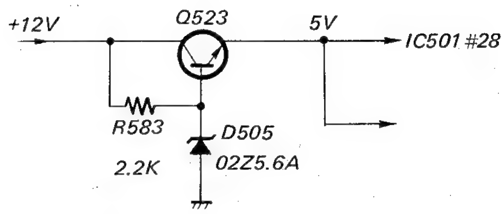


Fig. 3-41 5V Power Circuit

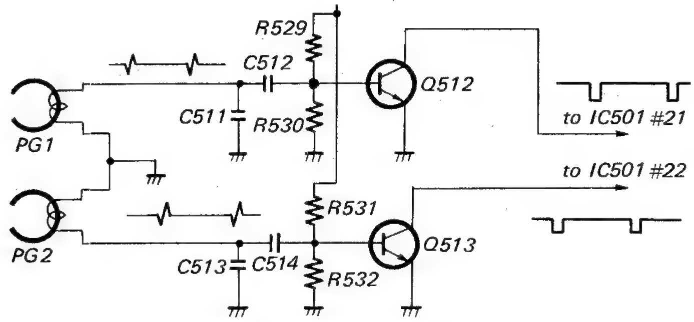


Fig. 3-42 PG Pulse Amplifier Circuit

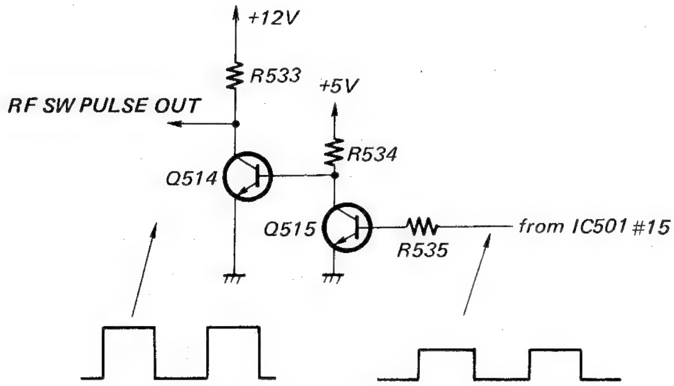


Fig. 3-43 RF-switching Pulse Amplifier

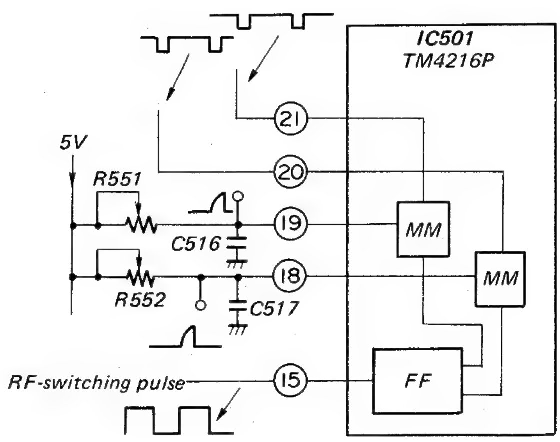


Fig. 3-44 RF-switching Pulse Process Circuit

Control Pulse Circuit

In the recording mode, as described previously, the 25 Hz signal produced by 1/2 counted down the vertical sync pulse is recorded as the control pulse through the control head onto tape. In playback, the control pulse is picked up for use as the input signal to the capstan servo APC (automatic phase control) loop and tape auto-find (program start location) detecting circuit. detecting circuit.

In recording, the recording +B voltage is applied to the base of Q508, which turns off. The diode D507 serves to make it sure that Q508 turns on or off. D506 prevents voltage from applying to Q508 when this is on in modes other than the recording mode. When Q508 turns off, the control pulse from Q509 is applied to the base of Q507, which inverts the polarity of the control pulse. The inverted control pulse is fed from the collector of Q507 through C503 to the control head. Q506 is turned on as the recording +B voltage is applied to its base through R507. In recording, the control pulse polarity-inverted by Q507 flows in the path of C503, the control head, R506, Q506, and the ground. Refer to Fig. 3-46.

In modes other than the recording mode, the recording +B voltage is not fed to the base of Q506, which turns off.

Q506, in turn, turns Q508 on. This applies voltage to the base of Q507, which turns on to ground C503. In the playback, rewinding, or fast-forward, now, the control head picks up and supplies the control pulse to pin 2 of IC502. The control pulse is amplified in IC502 and is fed out from pin 6. The output is applied to pin 13 of IC503. IC503 contains a Schmitt trigger, the output of which is a square wave fed out from pin 14. The square wave signal, which is applied to pin 24 of IC501, is used as the trigger pulse for the capstan servo APC (automatic phase control) loop in the playback mode. The output signal at pin 14 of IC503, also, is used as the trigger pulse for the tape auto-find detector, consisting of Q617 and Q623. The signal, further, is supplied to pin 9 of IC601 for use in producing a muting signal in the playback mode.

Refer to Fig. 3-47.

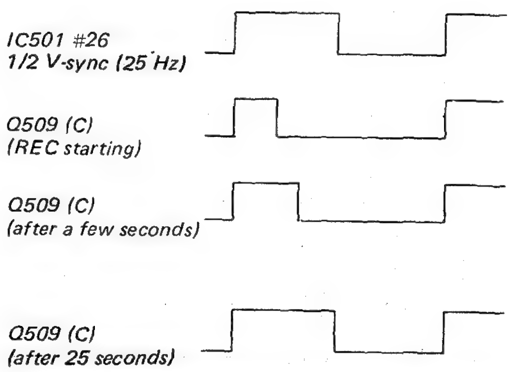


Fig. 3-45 Waveform of REC CTL Pulse

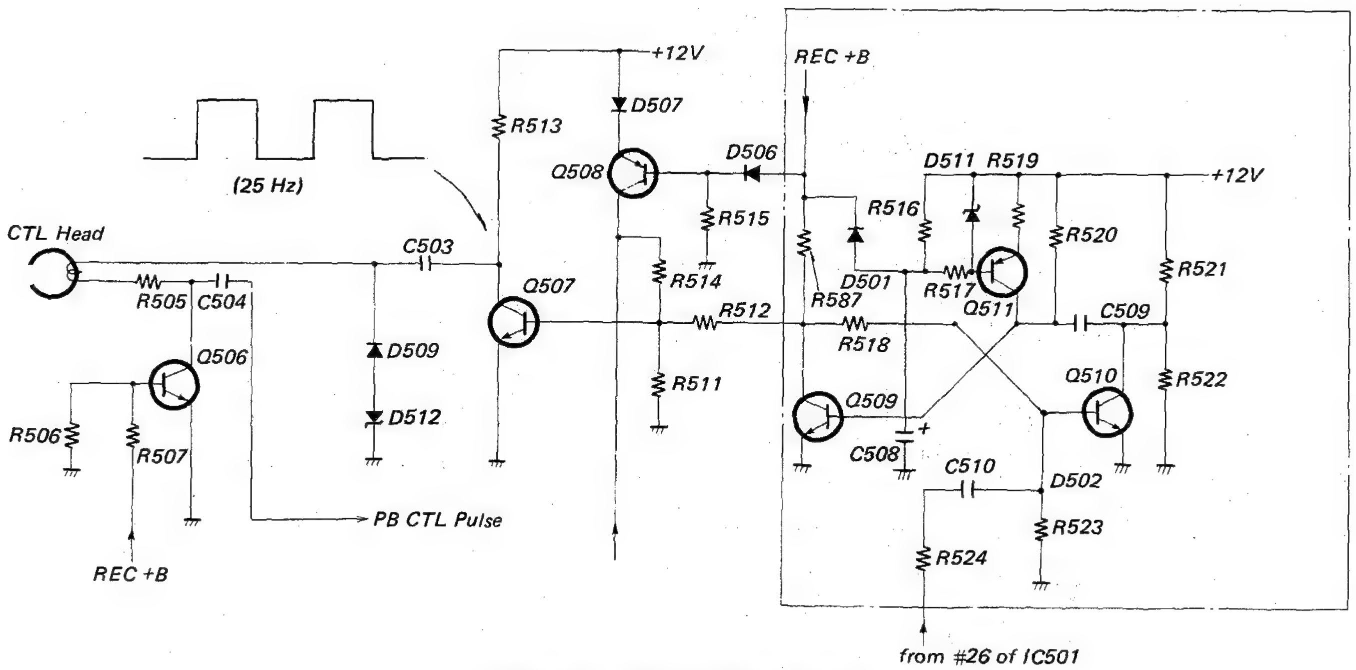


Fig. 3-46 REC CTL Pulse Circuit

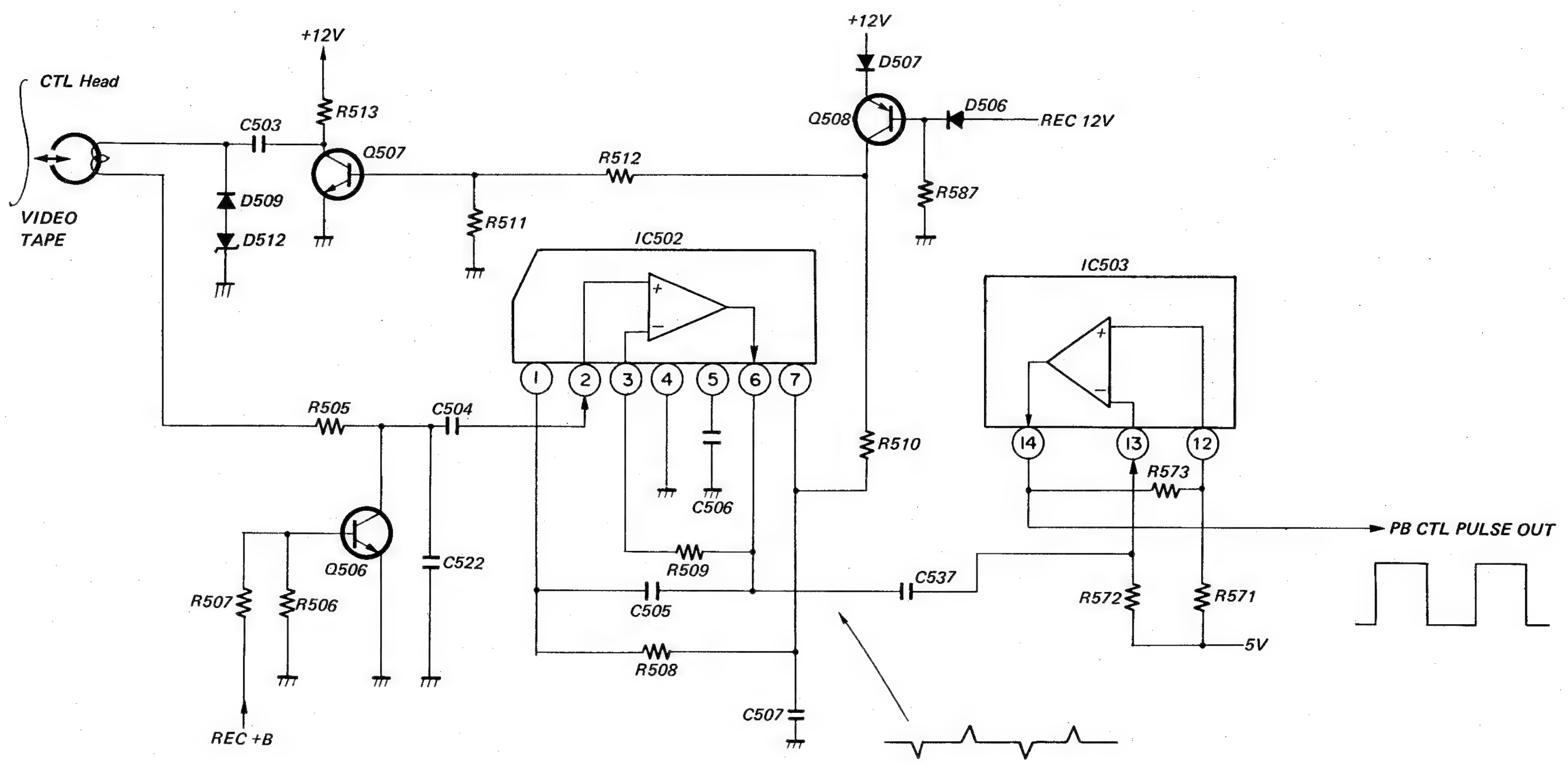


Fig. 3-47 PB CTL Amplifier Circuit

3-3-3. Head Servo Circuit

The head cylinder assembly is constructed mainly of an upper cylinder (fixed), a video head disk assembly (rotatable), and a lower cylinder (fixed). The video head disc assembly has magnet chips for generation of PG pulses. The lower cylinder has two PG coils, PG1 and PG2. The PG pulse developed by the PG1 is used for the head servo operation. PG1 and PG2 an combination, also, produce a RF switching pulse. As described previously, a trapezoidal wave has been formed in the manner that the vertical sync pulse 50 Hz is 1/2 counted down by a flip-flop to 25 Hz square wave, which is shaped to trapezoidal wave in IC. The trapezoidal wave is sampled by the gate pulses made by delaying the PG1 and PG2 pulses. The result is that the sampled voltage corresponds to the phase of the head with respect to the vertical sync pulse. When the magnet chip comes near the PG coil, this a negative pulse and when it goes out of the PG coil, this develops a positive pulse. PG1 corresponds to the beginning of the head B tracing and PG2 to that of the head A tracing. Each PG coil one pulse in every turn of the magnet chip. The position pulse output of the PG coil is used as a signal indicating the revolutional condition of the head.

Q512 and Q513 are pulse amplifiers for the PG1 and PG2 coils, respectively. If the PG pulse from the PG1 coil s positive, Q512 is turned on, which amplifies it to a negative amplitude as high as around 5 V at the collector. The negative pulse is applied to pin 21 of IC501. Similarly, the PG2 pulse is processed to a negative pulse fed to pin 20 of IC501.

Refer to Fig. 3-42.

The PG1 and PG2 pulses input to pins 21 and 20 are delayed by the monostable multivibrators to compensate for possible PG1 and PG2 position errors. The multivibrators, then, trigger the flip-flop to transform the pulses to 25 Hz square waveform. The amount of time delay can be adjusted with use of the time constant networks of R551 and R552 connected to pins 18 and 19, respectively. The pulse output of the flip-flop is applied from pin 15 of IC501 to Q515 and Q514 to amplify for use as the RF switching pulse. Refer to Fig. 3-43 and 3-44.

Also, the leading edge of the flip-flop output pulse, which corresponds to the PG1 delayed pulse, is used as the head servo phase comparison gate pulse.

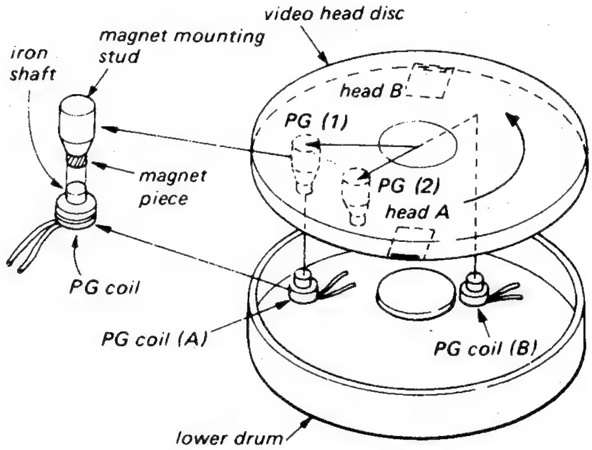


Fig. 3-48 PG Pulse Generating Mechanism

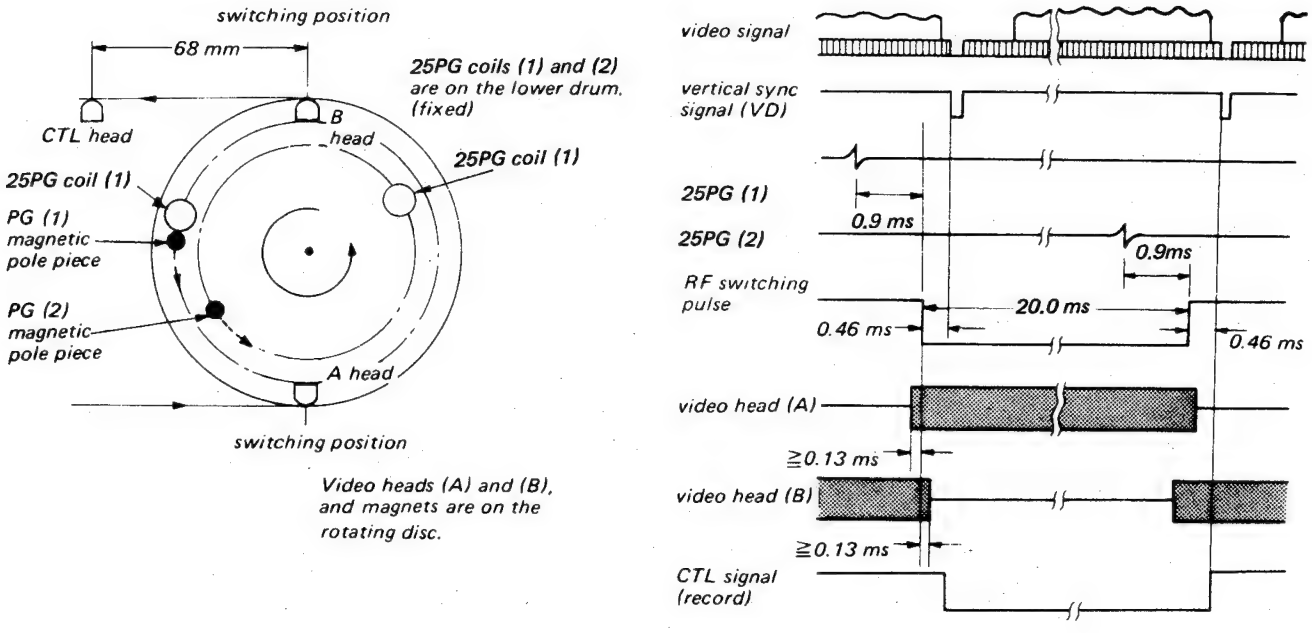


Fig. 3-49 Positional Relationship between Heads and PG Coils

As IC501 (TM4216P) is a digital processing IC, the reference 25 Hz signal made from the vertical sync signal clears the 15-bit reference counter, which is turn, starts counting the clocks. The count number of the reference counter is read out at the time of the leading edge of the switching pulse (corresponding to the PG1 pulse) made from the PG pulse. The 10-bit clocks corresponding to the slope of the trapezoidal waveform is stored in the memory.
With detection of the upper and lower limits, the contents of the memory is zero in the section A of the trapezoidal waveform and it is maximum in the section C. In the slope section B only, therefore, the memory stores the numeral proportional to the period of time from the reference pulse and the trailing edge of the switching pulse. To produce a voltage corresponding to the stored numeral, a duty-cycle modulator is provided. The duty-cycle modulator varies the duty cycle, or the pulse width, in connection with the stored numeral. The duty-cycle modulated pulse is intergrated through the low-pass filter, the output of which is a DC voltage proportional to the duty cycle. The 10-bit counter in Fig. 3-53 is always counting two-hold clocks. In the zero state, the 10-bit counter sets the R-S flip-flop. Each bit of the 10-bit counter is compared with the respective bits of the 10-bit memory by the 10-bit comparator. When the contents of the 10-bit counter coincides with that of the 10-bit memory, it resets the R-S flip-flop. The set-reset repetition rate is 1.46 kHz.

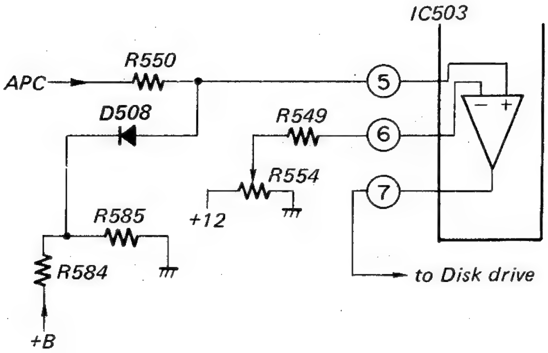


Fig. 3-50 Drive Circuit

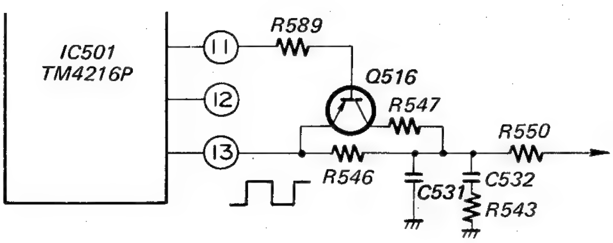


Fig. 3-51 AFC Circuit

The speed detector in IC501 holds the phase comparator output at a high level when the video head speed is lower than 1,500 rpm ± 1.7% or at a low level when it is higher than the range. In addition, if the video head speed is out of such a rated speed range, the speed detector sets pin 11 to a low level or if in the range, it sets pin 11 to a high level. This turns Q516 on or off, which changes the time constant of the video head start and slow-down compensation filter to provide quick lead-in on speed.
The APC signal output from pin 13 in the form of pulse modulation has the 1.46 kHz component filtered through the low-pass filter, consisting of R546 and C531. It is then passed through the phase compensation filter, consisting of R547, C532, and R548, and is connected as the AFC (speed control loop) signal to pin 5 of IC503 (TA75902P). The network of R550, D508, R584, and R585 turns on or off the disk motor revolution. In the stop state, the APC output voltage is at a high level. To pin 5 of IC503 is connected R584 and R585 through D508. The APC output voltage is divided by R550 and D508 with R585 to 0.7 V, approximately. Pin 6 on IC503, on the other hand, is preset to 2.5 V, approximately by R554 in the state when the APC is locked. The output of pin 7, therefore, is at a low level, at which the disk motor cannot be revolved. When an operating switch is depressed, +12 V is supplied to R584. This develops 4.2 V, approximately, at the cathode end of D508. This voltage turns D508 off, which allows the APC voltage to go to pin 5. The output at pin 7, then, becomes a high level, which allows the disk motor to start. The output at pin 7 is fed to the base of Q962 on the Disk Drive Circuit board PW2115. As the APC drive, the push-pull circuit, consisting of Q961 and Q963, activates the disk motor coil through the choke coil L961.
In the playback mode, the reference signal of the 5.97 MHz crystal-controlled oscillator X961 is counted down to produce a trapezoidal wave. This trapezoidal waveform, which is used in place of the 25 Hz square wave to which the vertical sync pulse was ½ counted down in recording, is sampled with use of the PG pulse and is processed for servo operation as in recording.

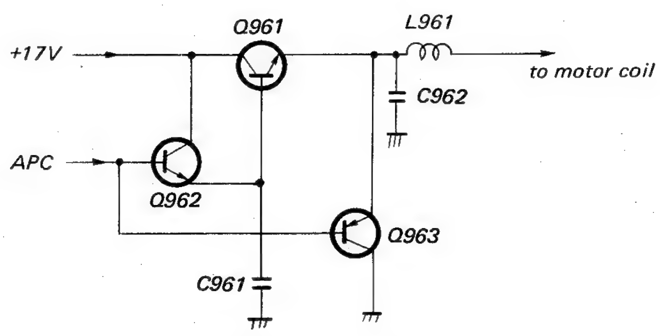


Fig. 3-52 Push-pull Amplifier Circuit

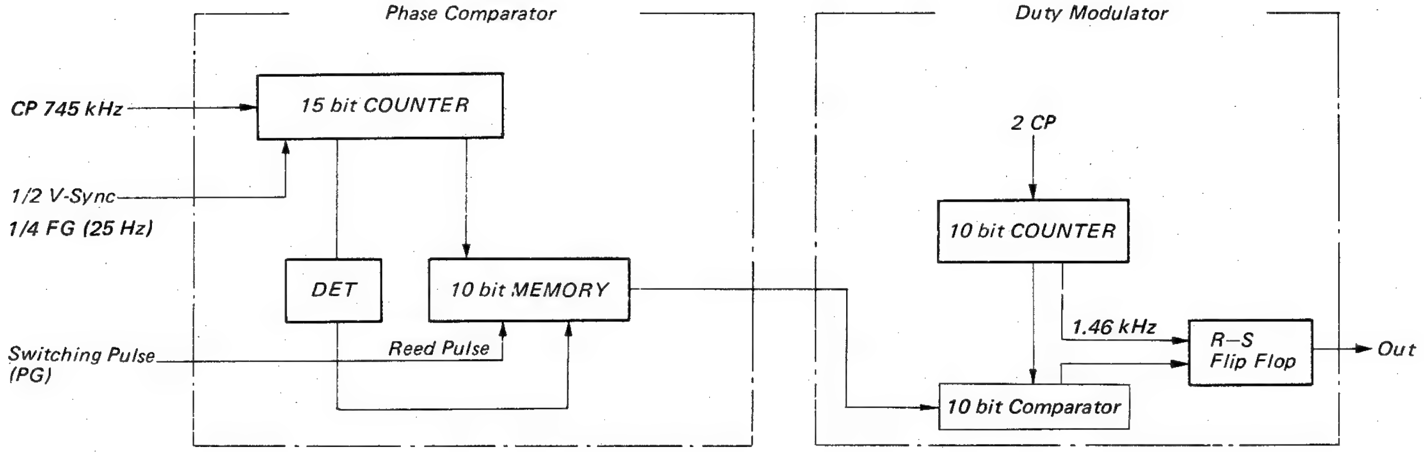
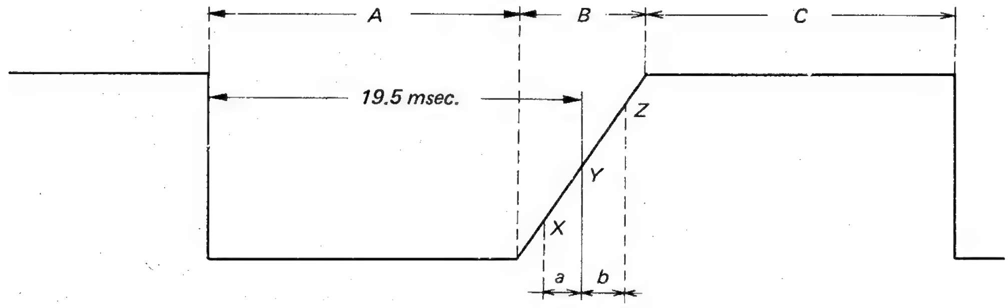


Fig. 3-53 Head Servo Block Diagram



a = 1.3 msec.
b = 1.3 msec.

Fig. 3-54 Phase Compare

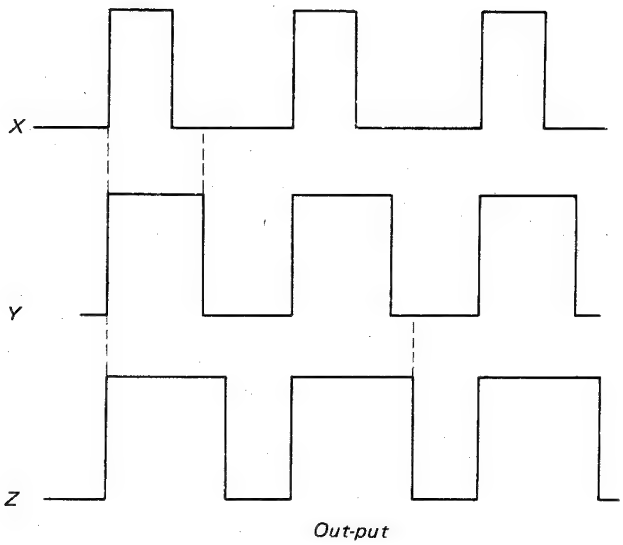


Fig. 3-55 Output (1.46 kHz)

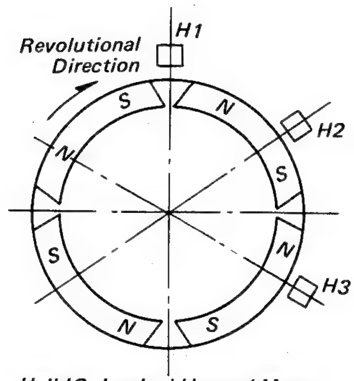
3-3-4. Brushless DC Motor Circuit

The video head disk is driven by a brushless DC motor. This section briefly describes operational principles of the brushless DC motor, basic circuit construction, and others. The operational pronciples of the brushless DC motor is identical with those of the conventional DC motors having brushes except when an electronic circuit is provided in place of the usual brushes and commutator. The motor may be broadly divided into a stator section and rotor section. These may be further classfied as follows.

- Stator section
  - Armature (3-phase winding)
  - Drive circuit board
    - Position sensor circuit
    - Coil drive circuit (switching)
- Rotor section
  - 4-split, 8-pole magnet
  - Magnet yoke
  - Others

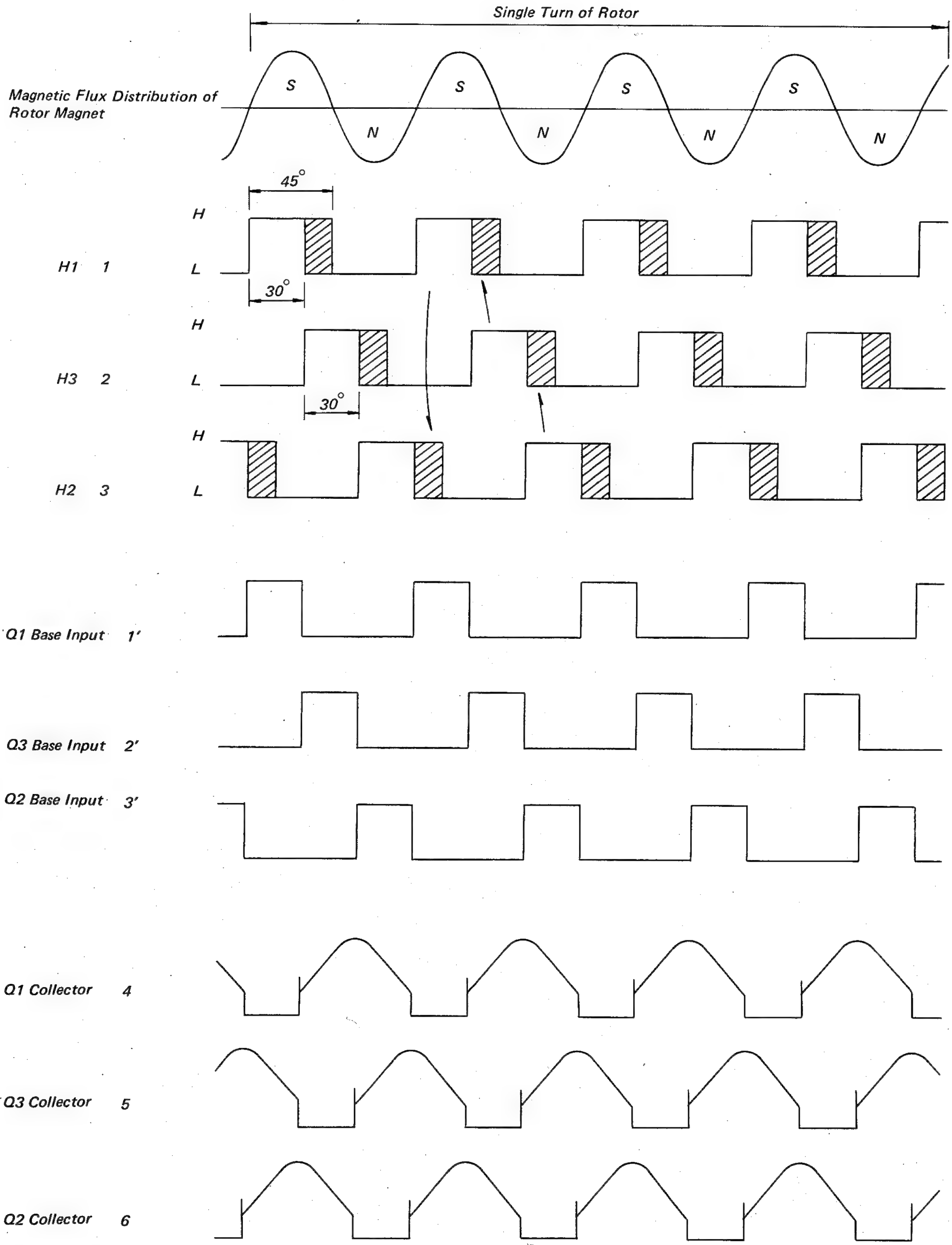
Fig. 3-58 shows the motor circuit. In the figure, H1 through H_3 are the position sensor elements (Hall ICs), Q_1 through Q_3 the coil drive switching transistors, and L_1 through L_3 the armature coils. The three Hall ICs are arranged at equal angle of 60 degrees. Each hall IC produces a low-level signal when the N pole of the rotor magnet comes close to it and a high-level signal when the S pole comes. As the rotor magnet is of 8 poles, a single turn of the rotor obtains signal of 4 cycles, which are deviated 30 degrees (120 degrees in electric angle) each other, as illustrated by the outputs 1, 2, and 3 on the timing chart in Fig. 3-57. The output signals cannot be applied to the bases of the switching transistors, however, because each signal makes two coils conduct in the shaded area at the same time. The result is that the motor fails to start because of unsmooth torque. To prevent this, Q_4 through Q_6 are connected to the outputs of H_1 through H_3 to cut out the shaded areas to obtain the signals 1' through 3', which are input to Q_1 through Q_3.

Let conduction of L_1 be started first. The output level of H_1 is high, which turns Q_1 on. This allows current to flow into L_1. Reaction of the current flowing through the coil and magnetic flux of the magnet revolves the rotor. When the rotor turns 30 degrees from the switching start position, then the output level of H_2 becomes high, which turns Q_4 on and Q_1 off. When Q_2 turns on, this allows current to flow into L_2. This operation repeats to turn the rotor 90 degrees. Then, switching of L_1, L_2, and L_3 is repeated in sequence, making the motor revolve smoothly. It is seen that a single turn of the rotor requires 12 times of switching. Note that as the conduction start time of each coil is correctly present by the positional relationship between the armature coil and Hall IC, timing adjustment is not needed. The Hall IC, therefore, should not be deviated, as this affects the performance of the motor.



Hall ICs Looked Upward Motor

Fig. 3-56 Hall IC Positions.



Single Turn of Rotor
Magnetic Flux Distribution of Rotor Magnet
S
N
S
N
S
N
S
N
45°
H
L
H1 1
30°
H
L
H3 2
30°
H
L
H2 3
Q1 Base Input 1′
Q3 Base Input 2′
Q2 Base Input 3′
Q1 Collector 4
Q3 Collector 5
Q2 Collector 6

Fig. 3-57

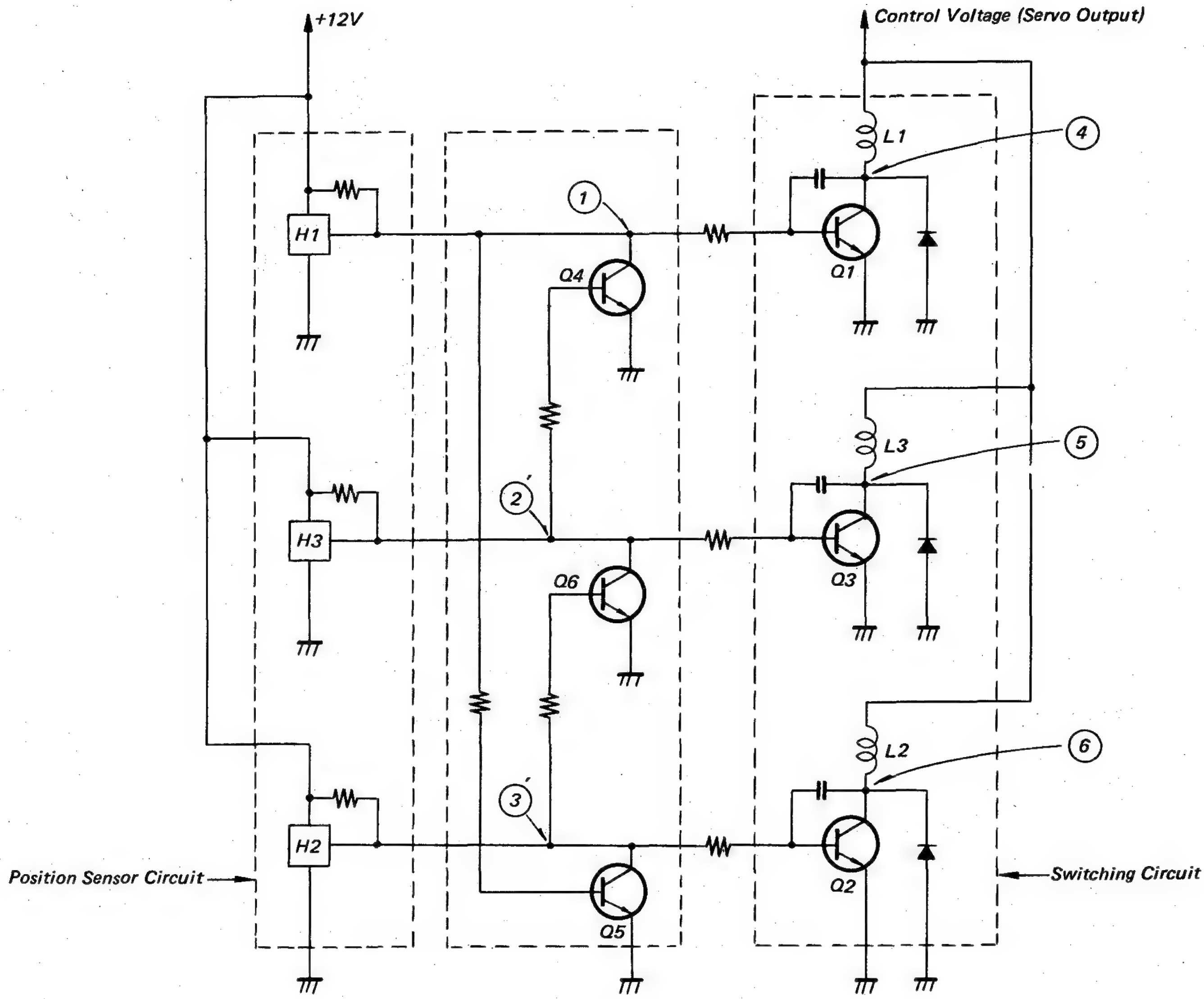


Fig. 3-58 Motor Circuit.

3-3-5. Capstan Servo Circuit

The capstan servo circuit, consisting of a speed control (AFC) loop and a phase control (APC) loop, controls the tape speed.

Speed Control (AFC) Loop

The speed control loop serves both for the recording and playback modes. A FG signal generating coil that is housed in the capstan motor produces a 100 Hz FG signal. The FG signal, which is input from pins 1 and 3 of the terminal P504 to pin 9 of IC503, is inversed and amplified by the operational amplifier. The FG signal, also, is shaped from sine wave to square wave and is applied from pin 8 of IC503 to pin 22 of IC501. The switch in IC501 is fixed at the position which is not connected to the 1/2 count-down circuit.
When the FG signal is input, the first block stores the contents of the counter. The second block clears the counter, which then, starts counting the clocks. When the second FG signal comes in, the contents of the counter clears and is stored in the memory. As in the phase comparison in the head servo circuit described, the contents of the counter is applied to the duty-cycle modulator for the slope portion only, but zero or maximum for the other portions.
The voltage corresponding to the period of the FG signal or the speed, therefore, is output in the form of duty-cycle modulation from pin 8 of IC501.

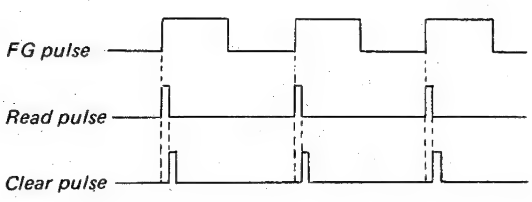


Fig. 3-59 Waveform of Output

Phase Control Loop (APC)

In the recording mode, the phase control loop compares the phase of the 25 Hz signal to which the FG signal has been 1/4 counted down with the phase of the reference 25 Hz signal to which the vertical sync pulse separated from the video signal has been 1/2 counted down. The operation of the phase comparison circuit, which is the same as that of the head servo circuit is as follows.
The reference 25 Hz signal clears the 15-bit counter, which then counts the clocks. The 25 Hz gate pulse made of the reference signal prompts the contents of the counter to be read out and stored into the memory until the 10-bit counts corresponds to the slope of the trapezoidal waveform. With detection of the upper and lower limits, these are stoped in the memory. The voltage corresponding to the contents stored is produced by the duty-cycle modulator. The duty-cycle modulator uses a 1.46kHz pulse to preset the 10-bit counter. The counter, then, starts counting two-hold clocks and at the same time, sets the R-S flip-flop. When the number of counted clocks is equal to the stored numeral, a reset pulse is input to the R-S flip-flop to reset. This continues until the memory is rewritten when the next gate pulse comes in. The output is fed out from pin 7 of IC501.
In the playback mode, the phase control (APC) loop compares the phase of the CTL pulse with that of the internal reference signal of 25 Hz to which the signal of the crystal-controlled oscillator X961 has been counted down. The APC loop output at pin 7 has the 1.46kHz component eliminated through the low-pass filter, consisting of R538 and C525, and is passed through the pase compensating fliter, consisting of R538, R540 and C526, and through R539. The signal, then, is mixed with the AFC output signal which also has the 1.46 kHz component eliminated through the low-pass filter, consisting of R541 and C527. The mixed signal is phase-compensated through R542, C528, and R547 and is applied to pin 3 of IC503. Note that the comparison bias for the DC amplifier in IC503 is given through R564 and R565.

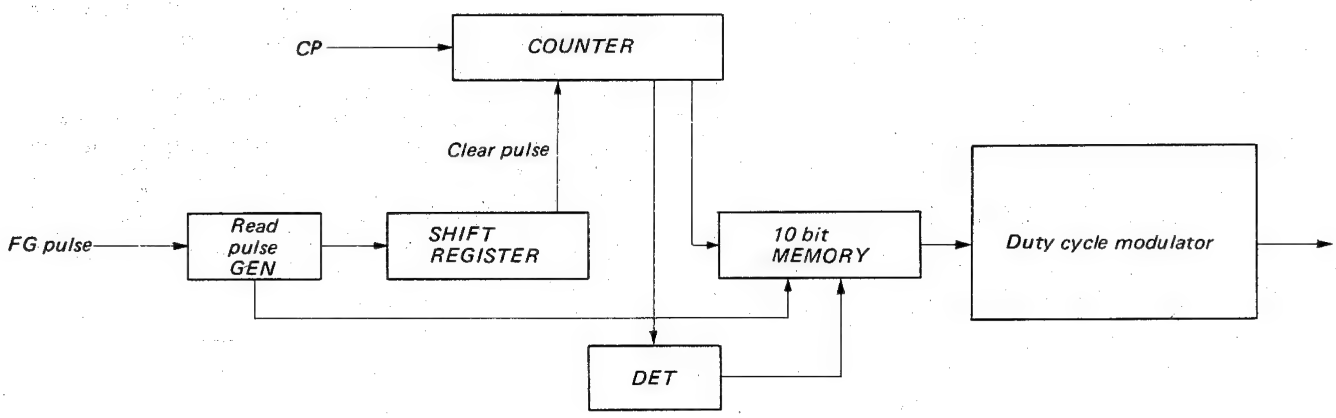
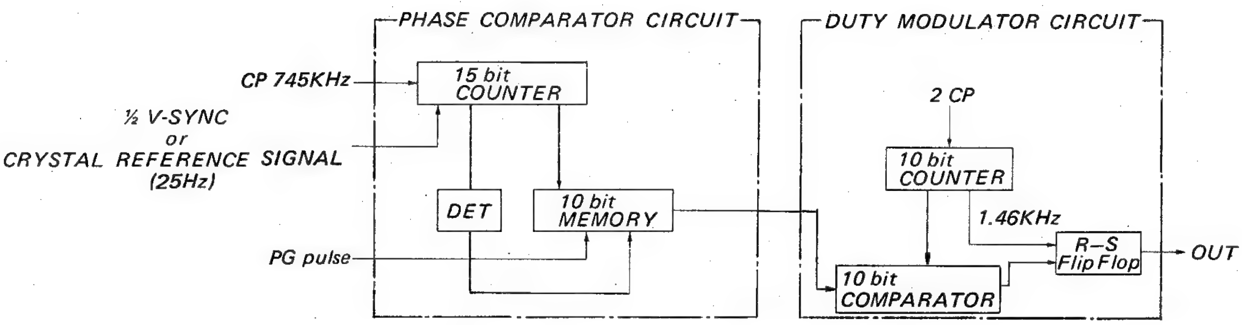


Fig. 3-60 Speed Detector Circuit Block Diagram



Phase Detector Circuit Block Diagram

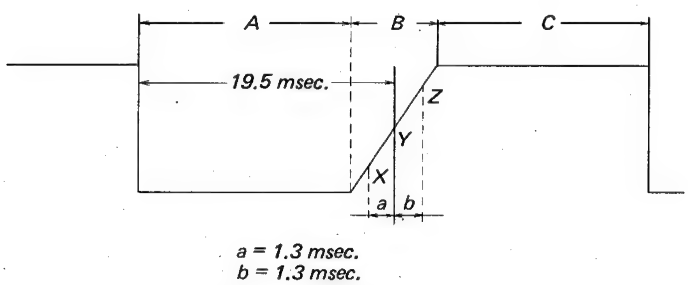


Fig. 3-61 Waveform of Comparator

Motor Drive Output Circuit

The capstan motor drives the capstan and reels. For reel drive, the recording or playback reel speed is different from the fast-forward or rewinding reel speed. The motor, therefore, is controlled by applying a motor on-off (revolution inhibit) signal and a fast-forward or rewinding signal to the output stage.

The control voltage is connected ot pin 3 of IC503 to amplify. The output signal is connected through pin 1 on IC503 to the speed control logic circuit to be processed appropriately. The signal, which is returned to the Servo Circuit again, drives the push-pull amplifier, consisting of Q519 and Q520 to revolve the motor. In the regular recording or playback mode of operation, the signal at pin 1 on IC503 is directly used for revolving the motor. In slowmotion, frame-feed, or still playback, the signal is formed in the speed control logic circuit to a capstan drive signal which is used for revolving the motor. In picture search, the control pulse that has been recorded on the tape is used by the speed control logic circuit to control the capstan motor so that the tape speed may be as high as 17 times, approximately, the regular speed. To this final stage is connected the +12 V power line directly from the Power Supply Circuit board PW2111 independent of the power line for the servo circuits mentioned previously. This prevents possible noise due to the capstan motor from affecting the other functional circuits. In the stop state, the motor turn-on signal does not come to Q522, which is off. This holds Q521 turned on, which grounds the base potential of Q519. This inhibits the capstan motor to revolve. If the recording/playback +B voltage comes in from D619 then the motor turns-on signal of +12 V applied to Q522, which is turned on. This turns off Q519, which allows the control voltage to be applied directly from pin 1 of IC503 to the bases fo Q519 and Q520. These drive the capstan motor to revolve. In the fast-forward or rewinding mode, the recording/playback +B voltage, also, is applied to the base of Q517, which is turned on. This allows current to flow through the base of Q518, which turns on. This allows the base potential of Q519 and Q520 to rise up to the +B voltage. The capstan motor, then, revolves irrespective of the control voltage.

C539 is placed for use of the charge current to turn on Q518, which allows the capstan motor to revolve, only when this is started. The reason is that when the PLAY or RECORD button is depressed, the control voltage is not always at a high level. C535, C536, R564, and R566 are placed for determining the DC amplifier gain of the control voltage and the response at high frequencies.

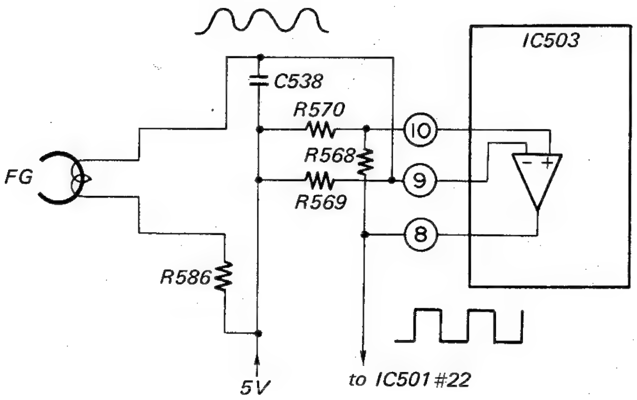


Fig. 3-62 FG Amplifier Circuit

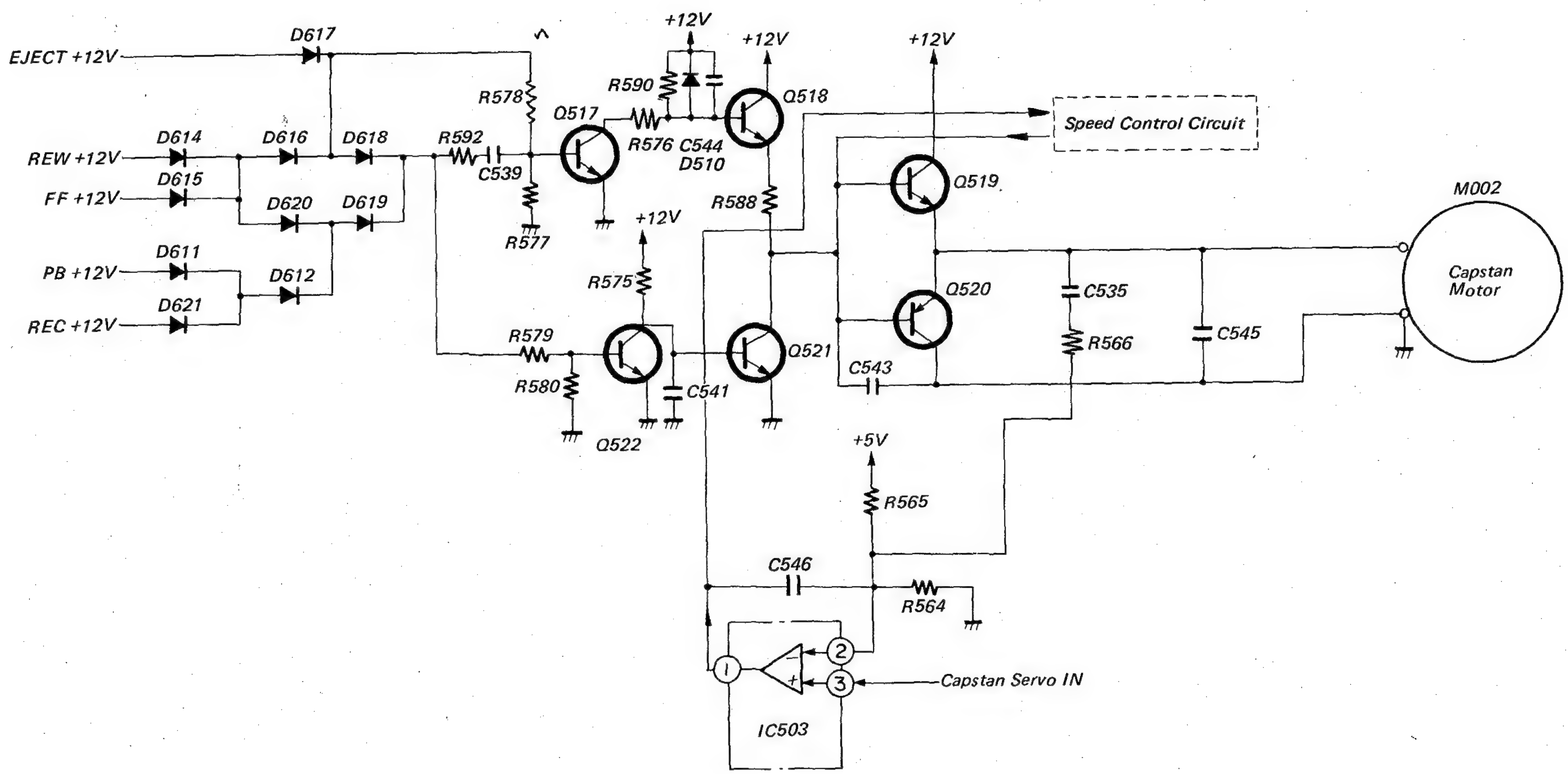


Fig. 3-63 Capstan Motor Drive Circuit

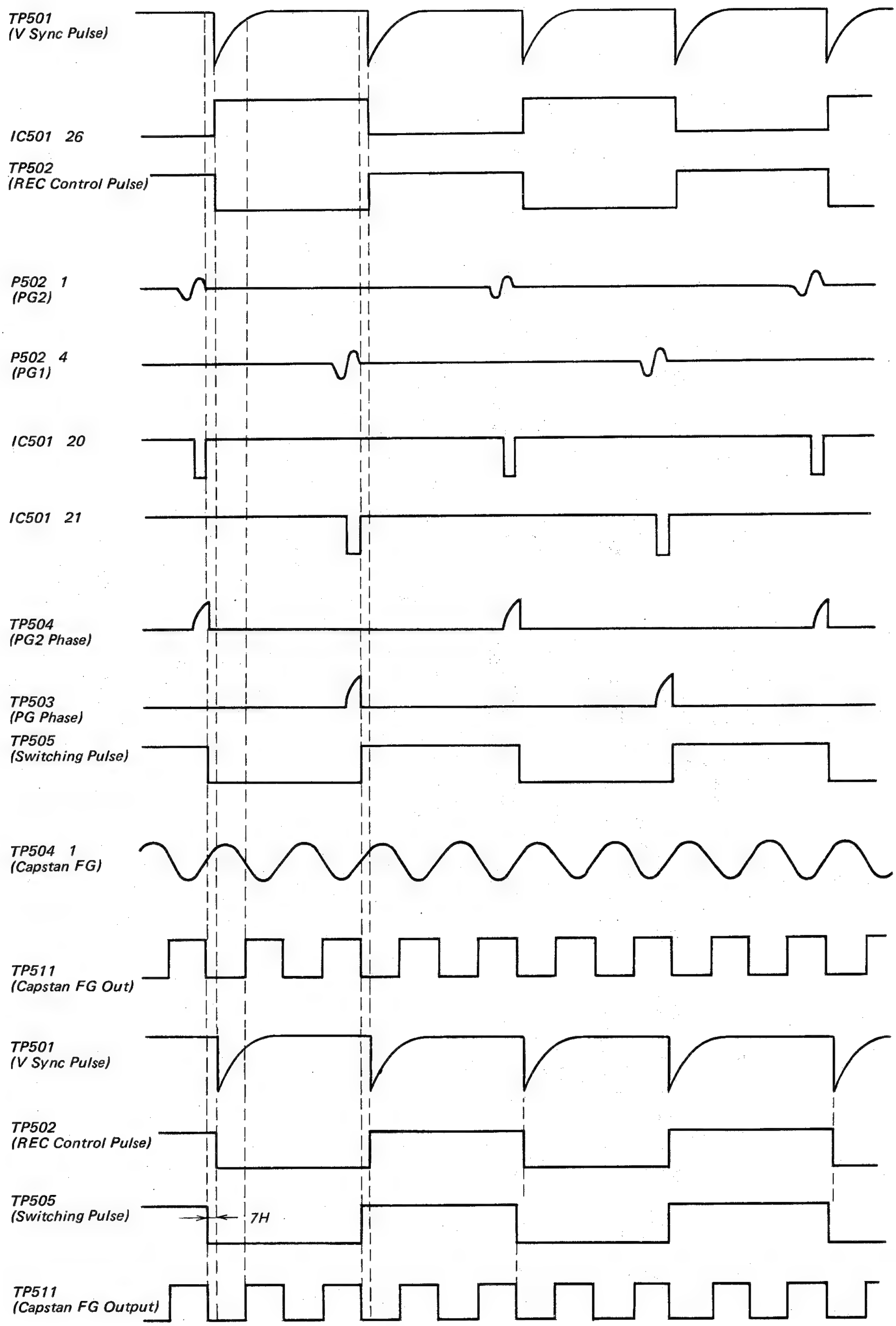
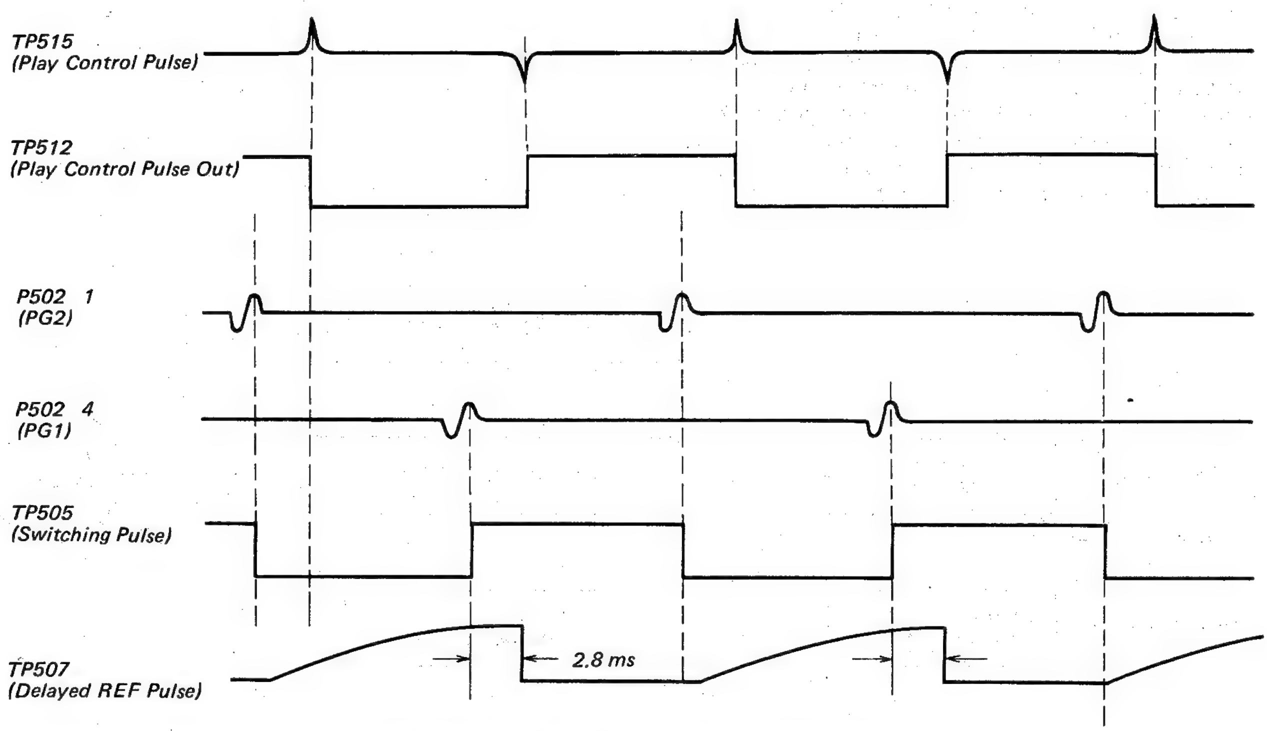


Fig. 3-64 Time Chart in Recording Mode of Operation.



Servo-detected signal outputs in recording and playback mode of operation

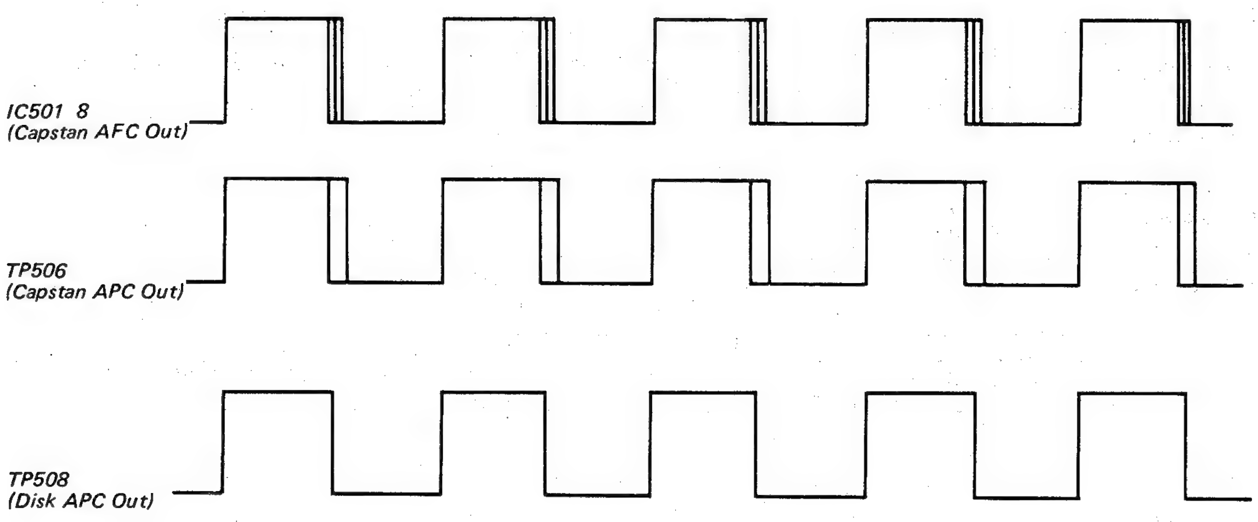


Fig. 3-65 Time Chart in Playback Mode of Operation.

3-4. LOGIC SYSTEM

GENERAL

The Logic Circuit includes as major circuits a loading/unloading switching circuit, a capstan revolution detector circuit, a dew detector circuit, a tape end detector circuit, a motor control circuit, and an "auto-finder" (program start locator) circuit. In addition, it has a disk revolution detecting circuit, a standby lamp lighting circuit, an auto-stop solenoid energizing circuit, a video/audio muting circuit, and others.

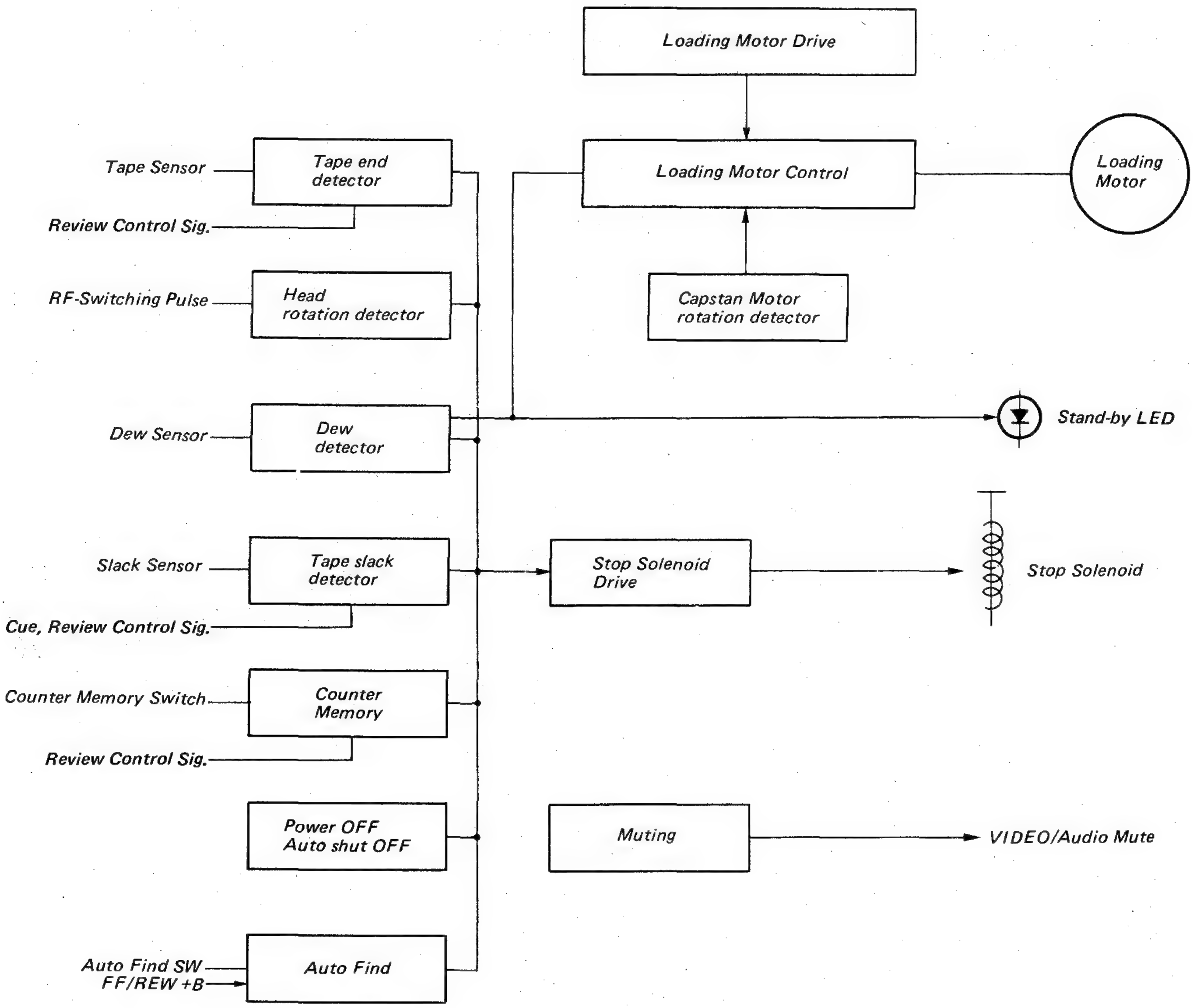


Fig. 3-66 Logic Circuit Block Diagram

3-4-1. Loading and Unloading Operation

When a cassette tape is inserted and the cassette compartment is pressed down, the cassette switch is turned on. This allows the loading signal to pass the loading end switch S671 to pin 9 of the terminal P608 on the **PW2110**. The loading signal, then, turns-on Q609, which grounds the cathode of the Standby lamp LED D983 on the Switch Circuit board **PW2116** to illuminate. The loading signal, also, is applied through R628 to the AND circuit at pin 19 of IC601 as a high-level input. The other input to the AND circuit is usually kept at a high level. The output of the AND circuit, therefore, is at a high level. As the output is connected to the NAND circuit, the output at pin 21 is at a low level. This turns Q631 off, the collector of which is at a high level. With turn-off of Q631, Q626 and Q629 are turned on, which allows current to flow to the loading motor to revolve.

When loading ends, the loading end switch S671 is turned off. The pin 19 of IC601, then, is turned to the low level and pin 21 is to the high level. This turns Q631 on, which stops the loading motor.

If the RECORD or PLAY button is depressed in the state mentioned above, the +12 V recording/playback voltage is supplied to pin 1 or 2 of the terminal P606. The +12 V, then, turns Q522 on, which in turn, turns Q521 off. This allows the capstan motor to revolve. The +12 V, also, sets the cathode of D508 to the high level, which allows the head disk motor to revolve. In the fast-forward or rewinding state, the +12 V fast-forward/rewinding voltage turns Q517 on, which turns Q518 on. This allows the capstan motor to revolve at a high rpm. If the EJECT button is depressed, also, the capstan motor is allowed to revolve at a high rpm as the +12 V eject voltage is supplied in a path as in recording or playback. The +12 V, also, turns Q624 and Q630 on. When Q624 turns on, this turns Q625 on, which in turn, turns Q627 and Q288 on. These allows the current opposite to that of loading to flow to the loading motor. The motor, therefore, revolves reversely for unloading the cassette tape. In the end of unloading, the cassette compartment is automatically popped up to turn off the cassette lead switch S691.

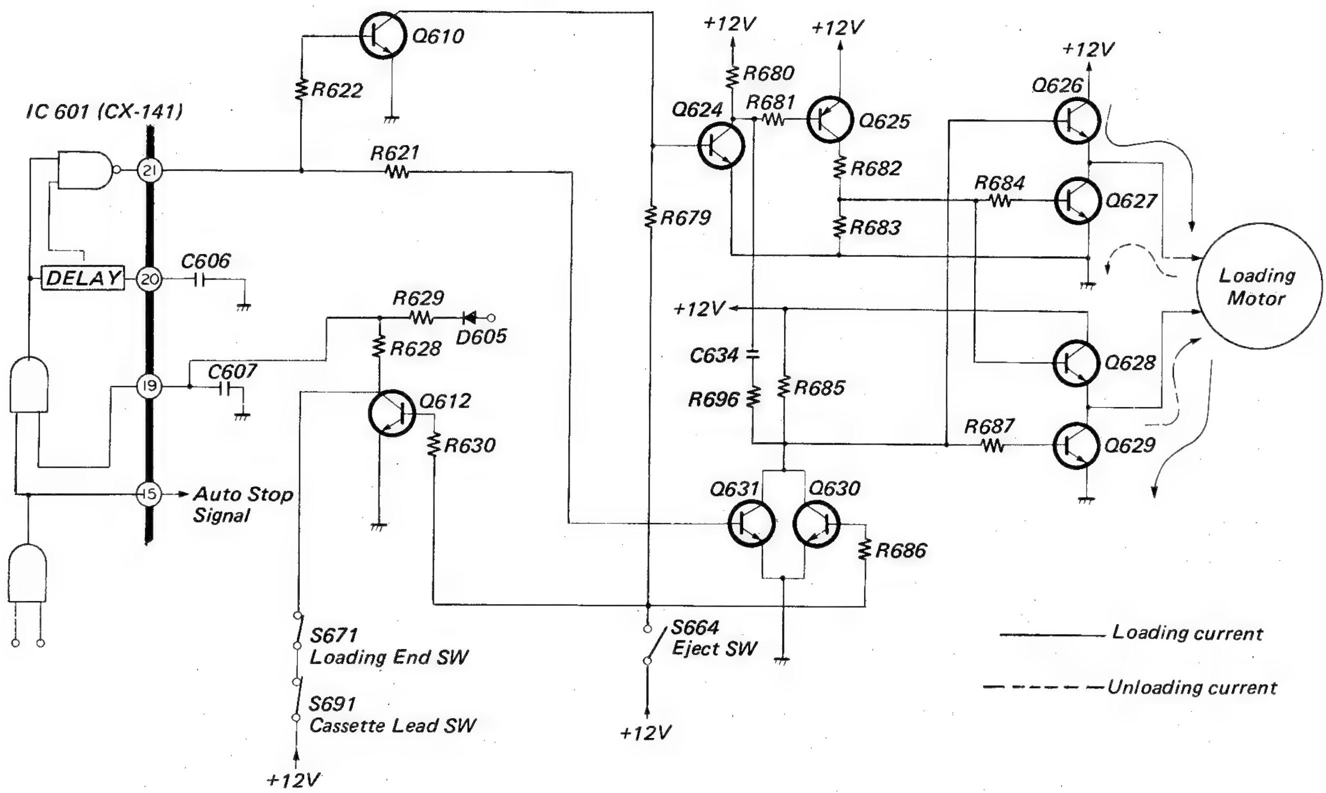


Fig. 3-67 Loading Circuit

3-4-2. Loading/Unloading Switching Circuit

In the loading state, Q624 is turned off, which turns Q625 off. This, in turn, turns Q627 and Q628 off. Q631 and Q630, also, are off, which apply biases to Q626 and Q629, which are turned on. These allow current to flow to the loading motor to revolve for loading the cassette tape.
In unloading, the +12 V EJECT voltage is connected to Q630 to turn on. This turns Q626 and Q629 off. The +12 V, also, is connected to Q624 to turn on, which in turn, turns Q625 on.
This biases Q627 and Q628 to turn on. Current, then, flows opposite to that of loading. The motor, therefore, revolves reversely. (Refer to Fig. 3-67.)

3-4-3. Loading Motor Control Circuit

This circuit controls the loading motor in the manner that the power line for the loading motor is turned off if the loading ring cannot be revolved by some causes during loading or unloading. In normal loading, the loading signal fed from pin 21 of IC601 is at a low level. In the event of abnormal loading, the low level changes to a high level in 10 sec approximately, set by the delay circuit the time constant of which is determined in terms of C606 and R623 at pin 20. The high level prompts Q631 to turn on. This turns Q626 and Q629 off, which in turn, stops the loading motor. In the event of abnormal unloading, similarly, pin 21 changes to the high level, which turns Q610 on, which turns Q630 and Q624 off. These turns Q625, Q627, and Q628 off, which stops the motor. See Fig. 3-67.

3-4-4. Capstan Revolution Detector Circuit

In the unloading state, tape is wound into the cassette as the reel table is revolved by the capstan motor, while being unloaded. If the loading ring turns without revolution of the reel table, the result is that tape would be damaged. To prevent this, a measure is provided as described below.
The FG head generates six pulses in series every turn of the capstan motor. Each pulse is amplified through IC503 and is rectified through D605 and D606 to DC voltage. The DC voltage controls the revolution of the loading motor. D623 is placed to prevent the square wave before rectification in the states other than the eject state.

3-4-5. Tape Slack Detector Circuit

The slack sensor, which is moved by the tape tension on the return side of the loaded tape, intrudes inwards to turn the lead switch on with slack of the tape. When the lead switch turns on, +B is allowed to go through the lead switch to pin 3 of the terminal P821 on the Slack Delay board PW1789. From pin 7 is applied the +B to pin 11 of the terminal Q903 on the Pause Circuit board PW2113 to turn Q910 on. This turns Q907 on, which supplies an auto-stop signal from pin 9 of the terminal P903 to pin 4 of the terminal P941 on the Plunger Drive board PW2114. The auto-stop signal flows as current through the current limiting resistor R942 to the stop solenoid L651 to energize. The diode D942 on PW2114 prevents reverse current.
As energizing the stop solenoid requires a high current at first, a starting current is needed. When Q910 is turned on, the +17 V line charges C903 which at the same time, turns Q908 and Q909. A high current, therefore, flows to the stop solenoid directly. Note that the current flowing through the current limiting resistor R942 serves to hold the stop solenoid energized. It is normally around 150 mA.

3-4-6. Auto-Shutoff Circuit at The Time of Power-Off

The auto-shutoff circuit, located on the Power Supply Circuit board PW2111, protects the VTR body and tape in the even of power-off due to accidental disconnection of the power plug from the wall outlet or service interruption. In the figure below, +B is connected to point a irrespective of the POWER switch, on or off. Q809, therefore, is normally kept on. Point b is connected to the base of Q910 on the Pause Circuit board PW2113 and point c to the hold capacitor C641 provided out of circuit boards. In the event power is interrupted, the collector of Q809 turns to a high level by the current discharged from C641 through R816. The current flowing from the collector through D812 energizes the stop plunger to attract.

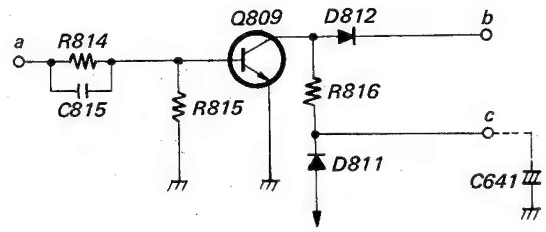


Fig. 3-68 Auto Shut Off Circuit

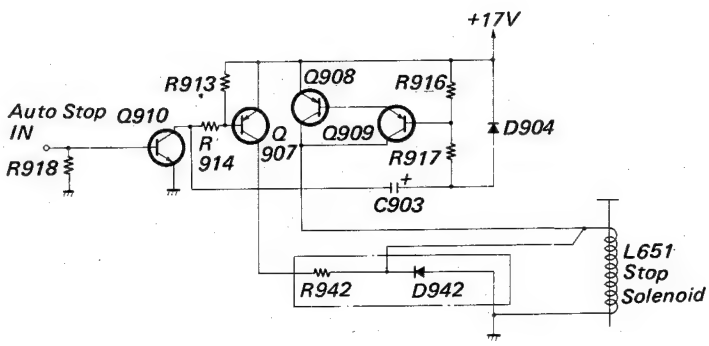


Fig. 3-69 Stop Solenoid Drive Circuit

3-4-7. Muting Circuit

When the PLAY button is depressed, the muting circuit mutes the video and audio signals for a while (4 to 5 sec) until they are made normal by stabilization of the servo circuits.

When the PLAY button is depressed, the playback +B is applied to pin 2 of IC601. To pin 9 in supplied the control signal, which is held by and output at a high level from the hold circuit. The high-level output of the hold circuit is applied as one input to the NAND circuit. The other input to the NAND circuit is a low-level signal of the +12 V having passed through the delay line. The output of the NAND circuit is high level. The high level signal is output as the muting signal to pin 18. The muting signal turns on Q251 on the Video Circuit board **PW2109**, thereby muting the video signal.

For muting the audio signal, the low-level, delayed playback +B is applied through pin 24 to Q603 to turn off, which outputs from the collector a high-level muting signal. The muting signal turns on Q704 on the Audio Circuit board **PW2108**, thereby muting the audio signal.

C604 connected to pin 24 is charged through R619. At the end of charge, the delay line output is made to a high level and pin 18 is turned to a low level. This, also, resets the audio muting state. The hold circuit discharges C608 during positive pulse of the control signal as long as this is input. This allows the NAND circuit to have the high-level voltage input. If the control signal disappears, the output of the hold circuit changes from the high to low-level in the time constant of R624 and C608. The output from pin 18, then, becomes high level for muting the video signal.

3-4-8. Dew Detector Circuit

The pulsating current to which the power current is half-wave rectified in the Power Supply Circuit board **PW2111**, is applied to and shaped to square wave by Q602. The square wave feeds through the dew sensor mounted on the lower cylinder surface to pin 3 of the terminal P601 when it is conductive. The dew sensor has a resistance of MΩ order across the electrodes in normal, but the resistance decreases to kΩ order when it senses moisture.

Such a low resistance allows the square wave to pass the dew sensor. The square wave, then, is rectified through D602. The rectified signal turns Q604 on and is amplified by this. The amplified signal is applied to the Schmitt trigger, consisting of Q605 and Q606, the collector of which is turned to a high level. This passes D624 to turn Q609 on, which illuminates the Standby lamp. At the same time, the signal from D624, also, passes D627 and is output as the auto-stop signal to energize the auto-stop solenoid. Note that when the dew sensor closes, Q607 grounds the loading signal to protect the tape.

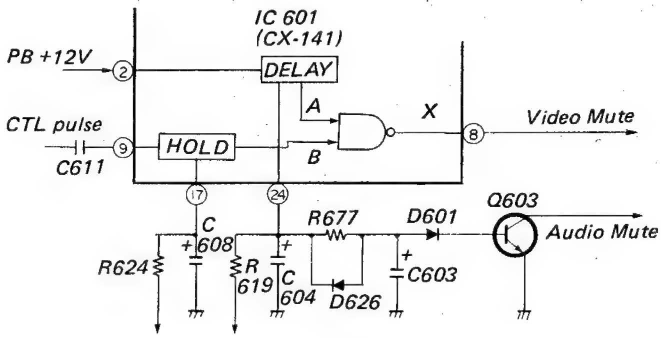


Fig. 3-70 Muting Circuit

State	Input Levels of "NAND" Circuit	Output Level of "NAND" Circuit
At start of muting	A : Low B : High	X : High
At end of muting	A : High B : High	X : Low
At no control signal	A : High B : Low	X : High

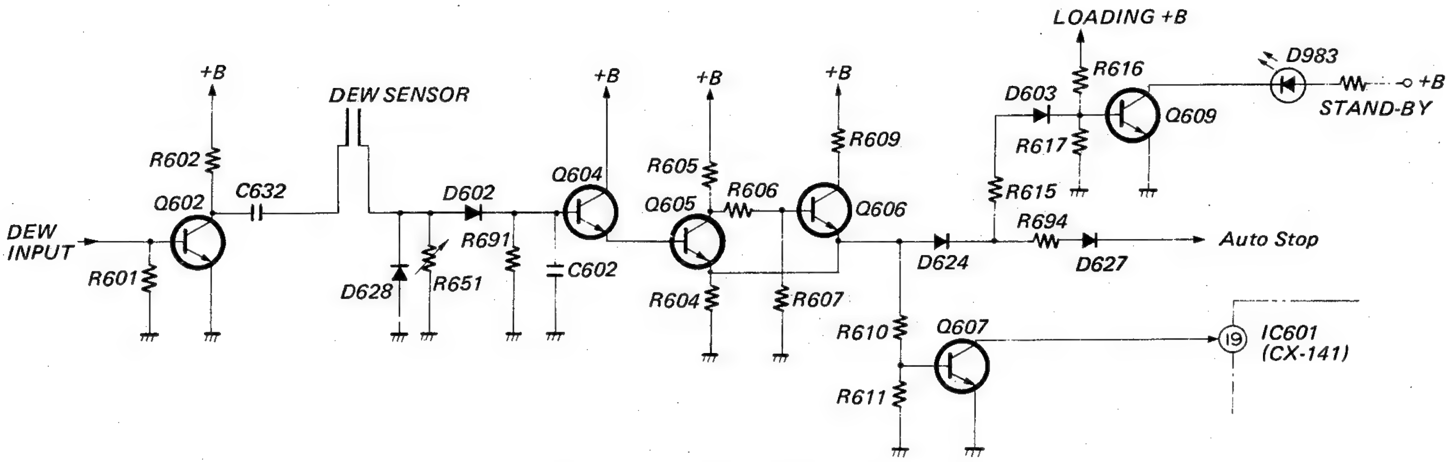


Fig. 3-71 Dew Detection Circuit

3-4-9. Auto-Find Circuit

The auto-find (programme start locator) circuit picks up the start of a programme recorded on the tape so that the tape can be automatically stopped at the start point from which the programme is to be started. Such as auto-find operation is made in the manner that a mark signal is put on the control signal as this is recorded on the tape, and is detected as the start sign while the tape is fast-forwarded or rewound. For details of processing the control signal to be recorded on the tape, refer to the Servo Circuit Section.

The control pulse picked up from the tape by CTL head in the fast-forward or rewinding operation is fed out from pin 14 of IC503. It, then, is differentiated by C616 and R636 to impulse, which triggers the multivibrator consisting of Q617 and Q623, having a time constant of 3.8 msec, approximately. In playback where the coming pulse is longer than the time constant, the multivibrator functions simply as the usual monostable multivibrator with input of positive trigger. In fast-forward or rewinding where the coming trigger has as short a width as 2.6 msec approximately, however, the multivibrator functions as a R-S flip-flop.

In fast-forward, +B is connected to the emitter of Q619, which is turned on as the base of Q618 is biased when the start of the programme comes. Q619, then, produces a positive pulse, which is differentiated by C622, R663, and R664. The differentiated pulse turns on Q913, which grounds pin 15 of IC601 through the AUTO-FIND switch S984 on the Switch Circuit board PW2116. With grounding of the output at pin 15, Q608 is turned on, which produces the auto-stop signal. This signal energizes the stop solenoid.

In rewinding, the +B is applied to the collector of Q620 and Q618 is turned on at the start of a programme. Q618, then, produces a signal, which is differentiated to positive pulse by C620 and R662. The positive pulse turns Q620 on, which produces the auto-stop signal. The signal energizes the stop solenoid as same as the fast-forward operation.

If the tape is fast-forwarded again after auto-finding of the programme start location, the step voltage caused by turn-on of the fast-forward +B is differentiated to positive pulse by C621, R665, and R666. The positive pulse turns Q621 on. This allows the pulse differentiated by C622, R663, and R664 to prevent Q913 from turning on.

In picture search, Q912 in the Pause Circuit (PW-2113) is turned on as its base is biased by the record and playback +B. Q912, then, turns Q911 off to inhibit the programme start locating action.

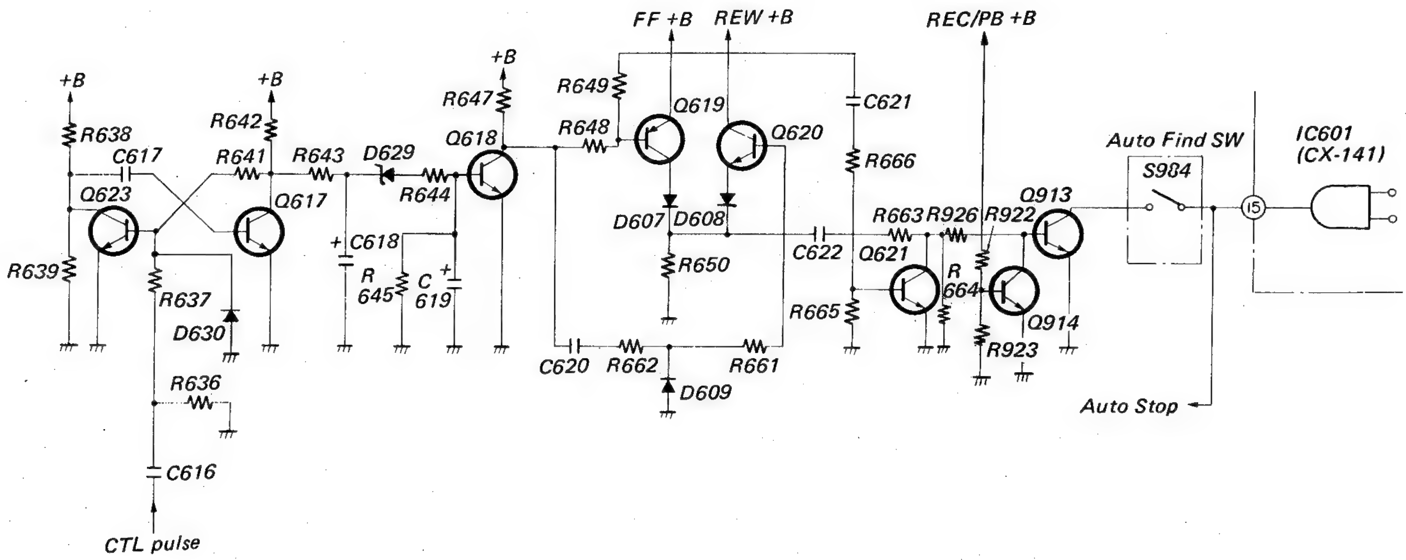


Fig. 3-72 Auto Find Control Circuit

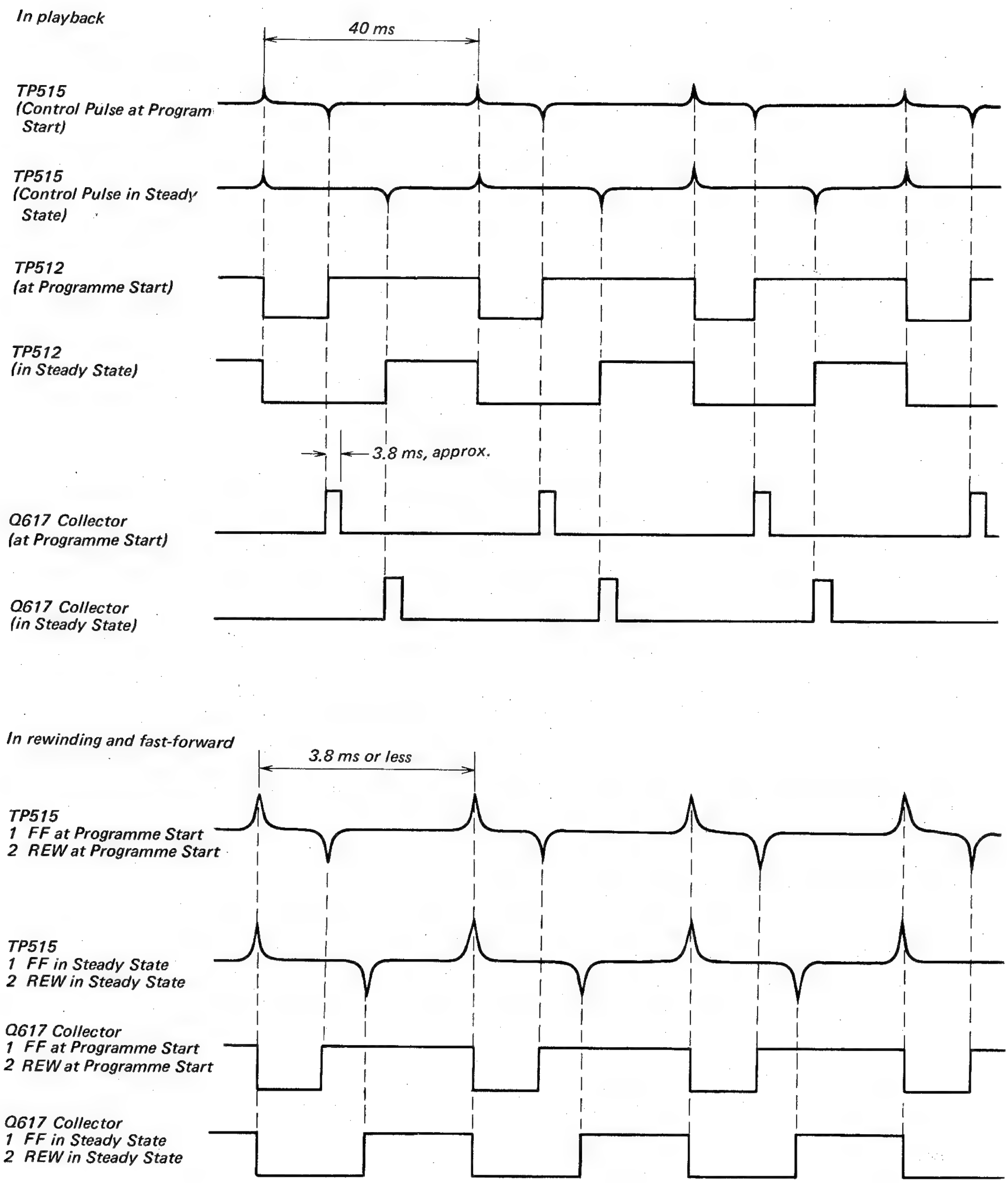


Fig. 3-73 PB/REW/FF, Auto Find Timing Chart

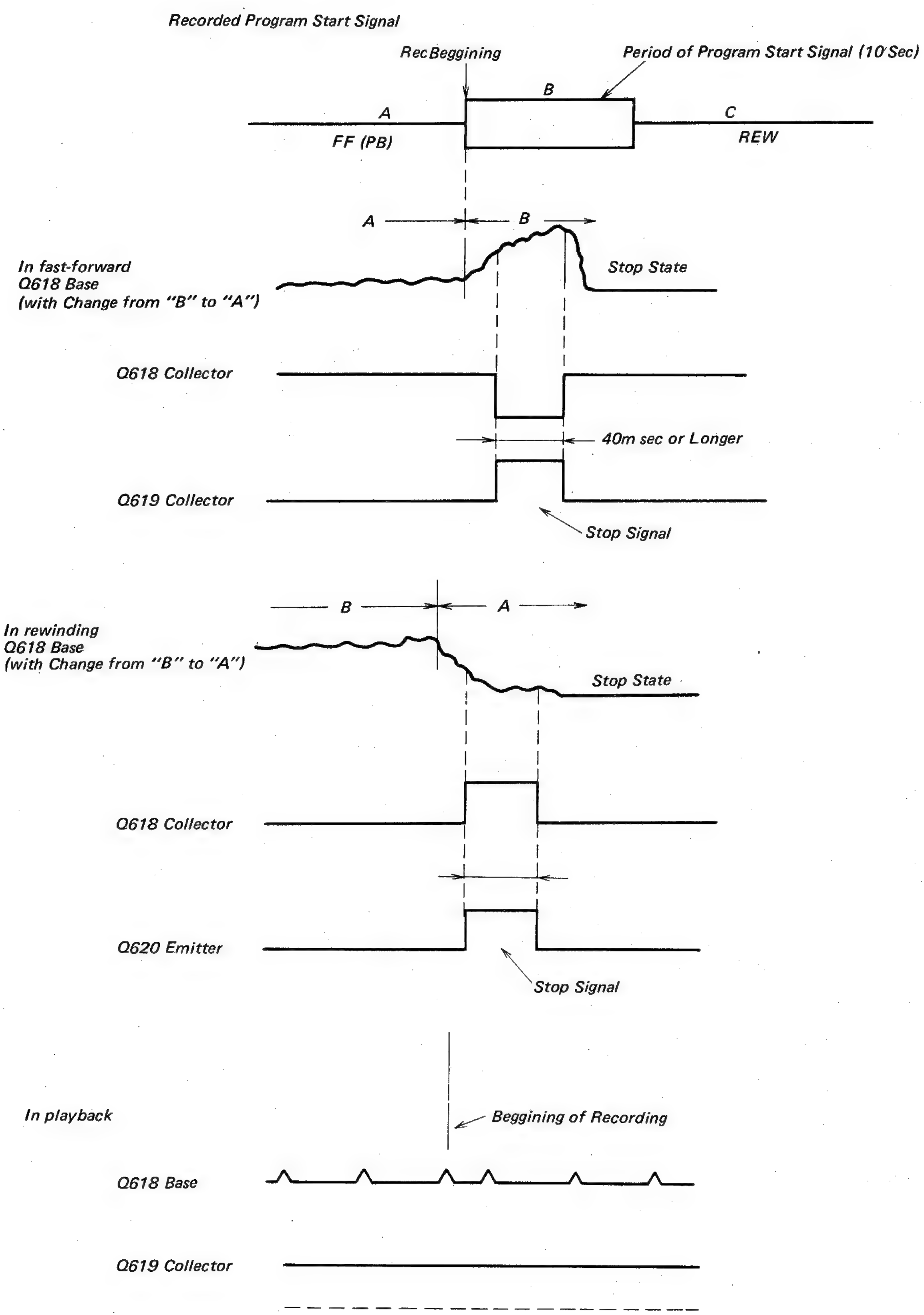


Fig. 3-74 Program Start Signal Waveforms Given in Various Modes of Operation.

3-4-10. Tape End Detector Circuit

The tape end detector circuit detects the end of the cassette tape and the stop solenoid drive circuit is operated to put the VTR into the stop mode.
The tape end or the tape beginning is detected by the use of two sensing coils and the metallic foil attached on each end of the tape.
In the cassette, metallic foil is attached to the leader tape at both ends of the tape.
The sensing coils are located near the tape on both the supply and take-up sides. The supply side sensing coil is for the PLAY, REC, and F.F. modes of operation where the PLAY button is depressed, including the frame-feed, slowmotion, and forward picture search and the take-up side for the REW modes of operation, including the reverse picture search. The tape-end detector circuit is shown in Fig. 3-75.
The tape-end detector circuit is composed of an oscillator circuit and a detector circuit. The sensing coil is the oscillator coil of the oscillator circuit.
Due to variation in Q of the coil when the tape reaches the metallic foil, the oscillator stops its oscillation. The auto-stop signal is obtained when the oscillation is stopped by detecting the oscillator output.
The oscillator circuit is located in IC601 (CX-141). The output is provided at pin 13 and is fed back through two feedback loops to both pins 10 and 11. Only one of the feedback loops is used at a time. The feedback loop consisting of C624, R653 and the supply side sensing coil is utilized in the PLAY, REC, and F.F. modes of operation where the PLAY button is depressed, including the frame-feed, slowmotion, and forward picture search.
The one consisting of C623, R652 and the take-up side sensing coil is used in the REW modes of operation, including the reverse picture search.
The feedback loops are selected by a DC bias supplied to pin 10 or 11. In the PLAY, REC or F.F. mode, the DC bias is supplied to pin 10 through the supply sensing coil.
When the bias is applied to pin 10, a feedback signal is fed to the oscillator and the oscillation starts.
The circuit connected to pin 11 is separated by a switch inside the IC.
In the REW mode, +12 V is applied to pin 11 as the bias voltage, and to the take-up sensing coil.
The oscillator output is half-wave rectified in the detector circuit, goes to the AND circuit and appears from pin 15 as a high level output.
The half-wave rectified signal is filtered by C609 to provide a DC voltage. When either metallic foil approaches its respective sensing coil, the Q of the sensing coil decreases and the oscillation stops. The output from the detector circuit goes low, and is applied to AND circuit. The output at pin 15 goes low also and the stop solenoid is energized.
When the tape-end detector circuit is operating, that is in the PLAY, REC, F.F., or REW mode or the respective frame-feed, slowmotion, or picture search, the detector circuit detects the oscillator output to provide a high level output.
When the no DC bias is applied to pin 10 or pin 11, the detector output goes automatically to a high level.

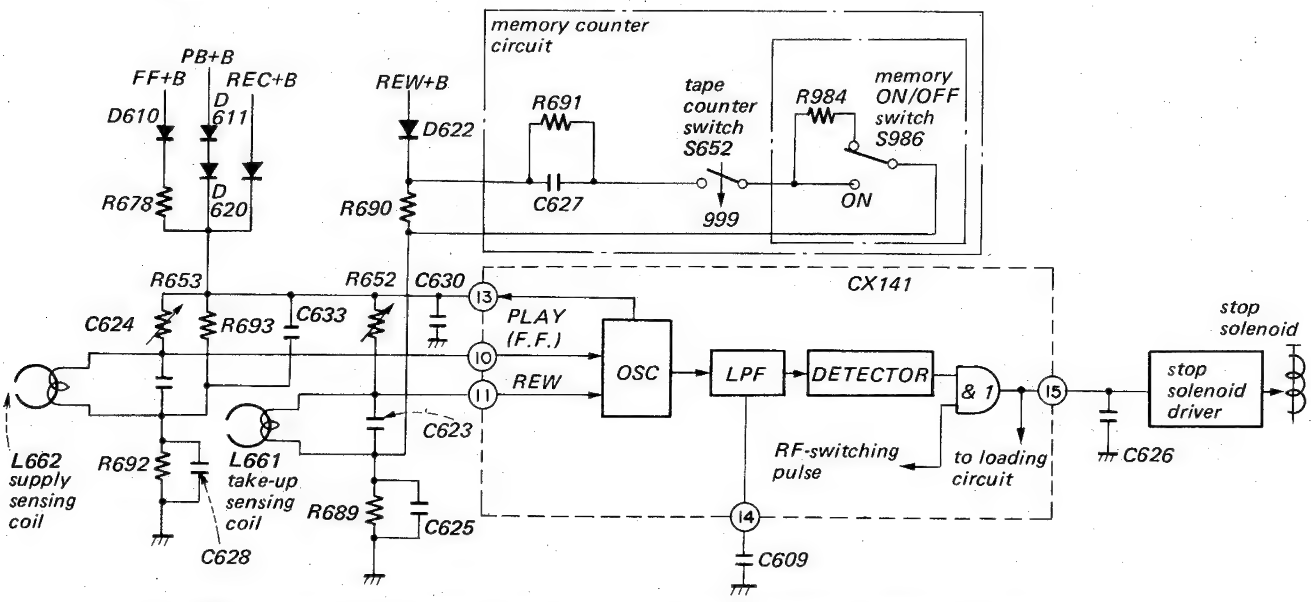


Fig. 3-75 Tape End Detector Circuit

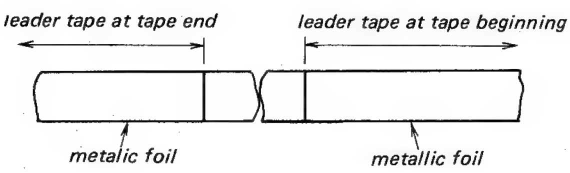


Fig. 3-76 Foil Leader Tape

3-4-11. Counter Memory Circuit

The system control of the VTR during the REW mode is automatically placed in the STOP mode by the counter memory circuit when the tape counter reaches "9999" indication. The counter memory circuit is included in the REW mode of the tape-end detector circuit as shown in Fig. 3-75. The counter memory circuit, utilizing the tape-end detector circuit, momentarily increases the bias voltage at pin 11 of the tape-end detector oscillating circuit up to the supply voltage. The oscillation is thus stopped for a moment for performing the auto-stop.
C627, the tape counter switch S652, and the memory switch S986 are connected in series across R690, bias

resistor of pin 11. The tape counter switch located inside the tape index counter unit is turned on when the tape counter indicates "9999". When the counter indicates "9999" and the memory switch is ON, the oscillation is stopped during the charging period of C627.
If the REWIND button is depressed once more after the VTR has been automatically put into the STOP mode, the REW operation takes place because C627 has been charged.
R984 located on the switch circuit board PW2116 prevents the VTR from being placed in the STOP mode automatically when the memory switch is turned on after the tape counter reaches its "999" position.

3-4-12. Head Revolution Detector Circuit

When the normal operation cannot be achieved due to the disk motor trouble or overload, it is necessary to put the VTR into the STOP mode. This is also required if the head disk does not rotate due to a broken disk motor. The head revolution detector circuit detects the head disk rotation by utilizing the 25 PG signal. When the revolution stops, it operated the stop solenoid drive circuit to put the VTR in the STOP mode. The detector circuit functions when the head disk motor rotates, that is when either the EJECT, the REWIND, the F.F., the PLAY, or the REC buttons is depressed.
The schematic diagram is shown in Fig. 3-77.
The detector circuit detects whether the head disk rotates or not by the presence of the 25 PG pulse. The RF switching pulse produced from the 25 PG signal supplied from collector of Q514 (pulse Amplifier) goes through C610 and R625, and is applied to the HOLD circuit in the IC601 pin 22.
When the voltage at pin 23 becomes higher than the reference voltage inside the IC, the HOLD circuit output goes from high to low.
If one of the function buttons is depressed, the REG 12 V charges C605 through R619.

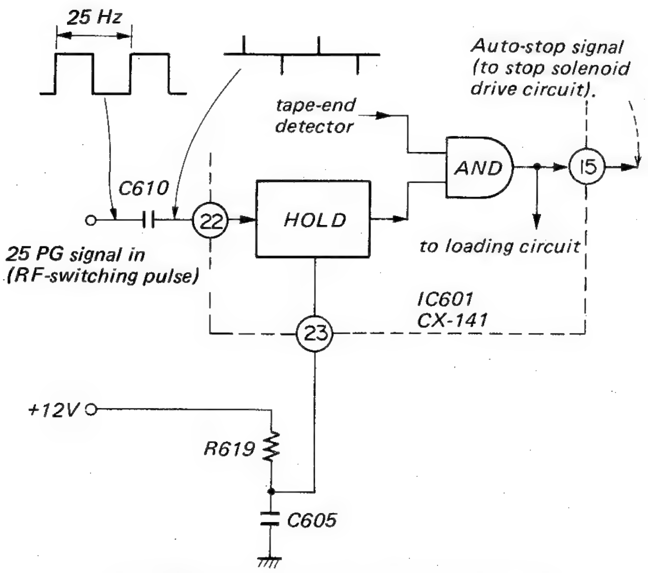


Fig. 3-77 Revolution Detector Circuit

If the 25 PG signal is not applied to pin 22 in this situation, the charge of C605 becomes higher than the internal reference voltage in about 0.5 second, and HOLD circuit output goes low. The AND circuit output goes low also, and the auto-stop signal is supplied from pin 15.

If the 25 PG signal is applied to pin 22, C605 is discharged in the IC during the positive period of the differentiated pulse applied to pin 22, and the voltage at pin 23 does not become higher than the internal reference voltage. The time constant consisting of R619 and C605 is set sufficiently longer than the 25 PG signal period.
The time constant is set to about 0.5 second because it must be longer than the rising time of the head disk motor when one of the function buttons is depressed.

3-4-13. Pause Circuit, PW2113

The Pause circuit operates in the manner that when the PAUSE/STILL switch or the video camera remote control switch, or the remote control pause switch is turned on, the pause circuit is set into the pause state, where the pause solenoid is energized to stop the tape transport.
Note that the video camera remote control switch is effective in the recording only. The pause state can be reset to the tape running state by depressing the PAUSE/STILL switch again.
It should be noted that when the pause state elapses 2 min 40 sec, this is automatically reset, but the pause state set by the video camera remote control switch cannot be reset.

RECORDING MODE

When the PAUSE/STILL switch is depressed in the recording mode, the pause still switch S983 is turned on. This applies the pause signal of negative pulse to pins 8 and 9 of the ICH09 on the Speed Control Logic circuit PW2117 and enters NAND circuit.
The output of NAND becomes high level and fed out from pin 10 to pin 3 of ICH05.
The pause flip flop in ICH05 is triggered by this signal and its output becomes high level as flip flop is inverted.
The output of the pause flip flop is applied to the base of Q906 on the Pause circuit PW2113 and pin 12 of ICH06. Then, Q906 turns on and the pause LED D984 illuminates.
At the same time, the pause signal which is fed to pin 12 of ICH06 enters AND circuit. The other input of AND is REC +12V.
Therefore, the output of AND is high level and fed to the base of Q904 on the Pause circuit PW2113 through DH03.
At the time of start, Q904 allows a current through R904 and R905 to charge C901.
This turns Q902 and Q903 on, which allow a high current to flow through pause solenoid to energize.
At the same time, Q901 is turned on to allow a current to flow through the current limiting resistor R942 on the Plunger Drive board to the pause solenoid to hold. When C901 is fully charged, Q902 and Q903 are turned off, but Q901 is on only to hold the pause solenoid energized.

PLAYBACK MODE

When the PAUSE/STILL switch is depressed in the PLAY mode, the pause solenoid is not energized.
That reason as follows.
The pause signal is supplied as same as the RECORD mode.
However, the input of pin 12 of ICH06 turns to low level, because the REC +12 V is not supplied in PB mode.
Therefore, the output of AND turns low level and the pause drive circuit consisting of Q901, Q902, Q903, and Q904 is cut off.
As the REC +12 V is cut off and the input of pin 9 of ICH07 turns low level, the output from pin 8 of ICH07 becomes high level in PLAY mode.
This output is fed to pin 8 of ICH06 and enters AND circuit.
The other input of AND is a high level which is supplied from pin 1 of ICH05 pause flip flop.
The out put of AND which is a high level is fed to the base of QH14.
QH14 turns on and capstan servo signal is grounded through DH18.
Thus, capstan motor stops and tape transportation also stops when depression of PAUSE/STILL switch in PLAY mode. Refer to Speed Control Logic description for more details.

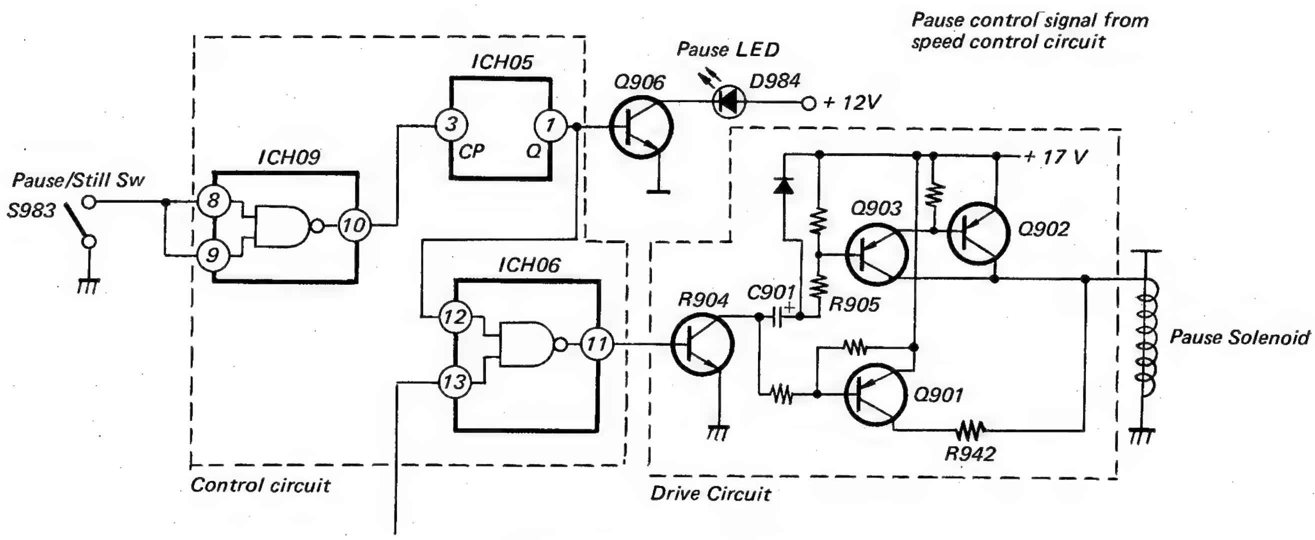


Fig. 3-78 Pause Circuit

Mode	ICH06			ICH05
	pin 12	pin 13	pin 11	pin 1
STOP	L	L	L	L
RUN	L	H or L	L	L
Pause (REC)	H	H	H	H
STILL (PB)	H	L	L	H

H .... High level
L .... Low level

3-5. SPEED CONTROL LOGIC CIRCUIT, PW2117

3-5-1. GENERAL

The Speed Control Logic Circuit, contained on PW-2117, is provided for controlling special playback modes or picture search modes of operation, which include a still or slow motion playback, a frame feed playback, and a cue or review playback. For each of the picture search modes of operation, the Speed Control Logic Circuit feeds a necessary control signal to the Video Circuit PW2109, Servo Logic Circuit PW2110, or Disk Drive Circuit PW2115. Note that in the pause or still state, also, it contains a circuit which serves to automatically reset the pause or still state in approximately 3 minutes, thereby protecting the tape from damage.

The Speed Control Logic Circuit consists chiefly of a C^2-MOS IC and diodes which form logic circuits for determining a specific picture search mode of operation. The Circuit may be divided into: (1) a picture search mode selector circuit, (2) a still/slow motion circuit, (3) a frame feed circuit, (4) a tape speed control circuit in the cue or review state, and (5) others. Note that the frame feed circuit has a noise position detector circuit for frame registration. In the following sections will be described the operation of the Speed Control Logic Circuit in detail in the order of the still/slow motion, frame registration, and cue and review.

3-5-2. Still/Slow Motion Circuit

Still/Slow Motion

For still state, the capstan motor is stopped to halt tape with leaving the pinch roller pressed to the capstan. By depressing the PAUSE button during playback, the pause flip-flop in ICH05-1/2 is set for still state. In the still state, QH14 in Fig. 3-79 is turned on. This grounds the capstan servo signal fed from QH22 through RH88 and DH18, thereby stopping the capstan motor.

In the still playback with the video tape stopped, each video head traces on a skew with respect to the video tracks as illustrated in Fig. 3-80. The RF output signal played back in such a skew tracing is shown in Fig. 3-81 where the RF switching pulse also is illustrated. As a single TV picture frame is composed of two fields, A and B, the still picture frame also has two fields composed.

If the SLOW control is turned in the still state, QH16 and QH15 in Fig. 1 are turned on. This causes the still picture to move, or changes it to slow motion picture. Turning the SLOW control from point A to B in Fig. 1 changes the bias to QH16, which turns QH15 on. This switches the still state to slow motion state. The collector output of QH16 is fed through DH19 to the capstan motor. The collector voltage of QH16 is changed with the SLOW control. This means that the slow motion rate can be changed by the SLOW control.

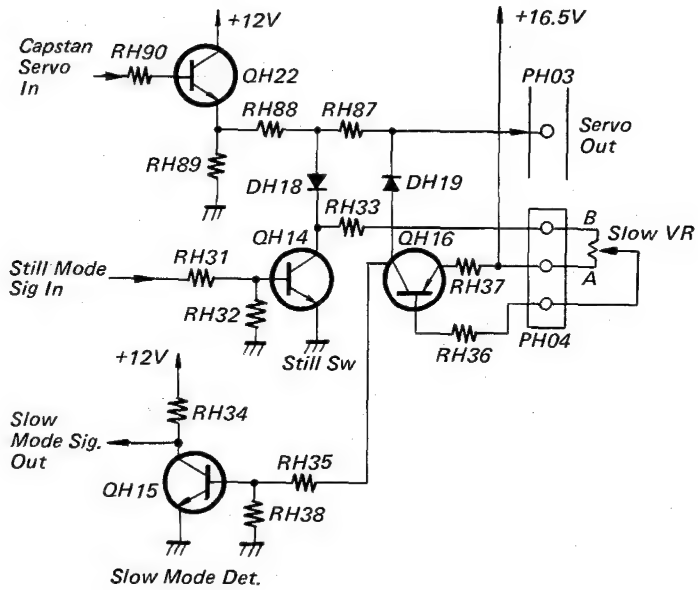


Fig. 3-79 STILL/SLOW Control

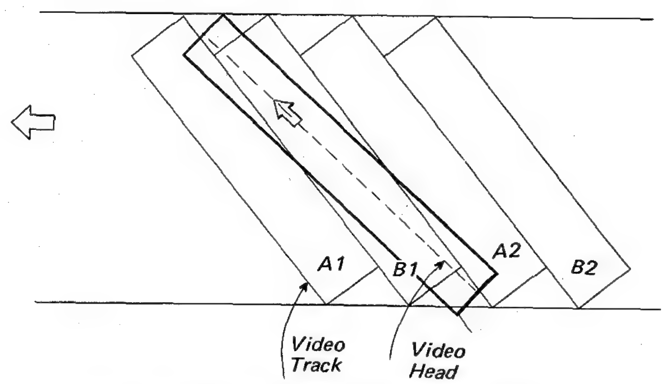


Fig. 3-80 Video Head Trace in Still State

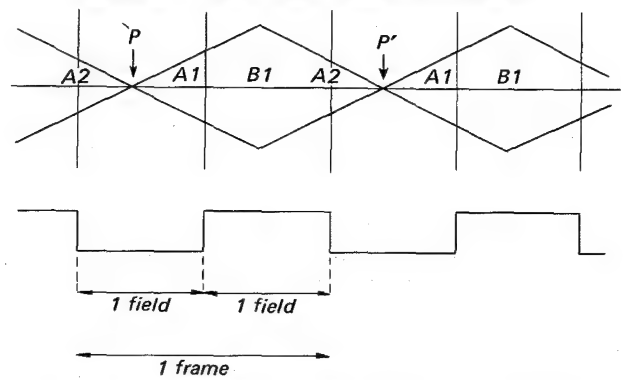


Fig. 3-81 Playback RF Signal Output In Still State

Fig. 4

Frame Registration

If the video tape is stopped in a wrong time for a still picture, there may appear streaking noise on the TV screen. Such a noise, if existing on the center of the picture, disturbs the viewer in seeing it. To prevent the streaking noise from entering the screen, frame registration is needed so that the noise signal may be included in the period of vertical blanking. To achieve frame registration, the capstan motor is driven by pulse to move video tape a little. The streaking noise in the still state is due to decrease of the playback RF output at point P or P' in Fig. 3-81 because of skew tracing of the video heads on the video tracks as in Fig. 3-80. The points P and P' can be shifted to position by the frame registration that the little shift of the video tape moves the video tracks in relation to the video heads. A principle of the frame registration is as follows. The blanking period of the TV picture nearly coincides with the vertical sync pulse. As the leading or trailing edge of the RF switching pulse is at 7 Hs before the vertical sync pulse, frame registration can be accomplished by comparing the noise position in the still state with the phase of the RF switching pulse.

A block diagram of the frame registration circuit is shown in Fig. 3-82 and the operation timing chart in Fig. 3-83. In the figures, the noise stop position is determined by the delay time of the monostable multivibrator ICH02-1/2A in reference to the RF switching pulse and ICH02-1/2B produces a stop position signal (see (d), "STOP" signal, in Fig. 3-83). The noise stop signal (d) is compared in ICH08-1/2A with the phase of the noise position signal (e) output of the noise position detector circuit, which will be described in Section 3-5-3. If the two signals (d) and (e) are not in phase, the signal Q at pin 2 on ICH08 is high. This makes the drive pulse gate ICH09 open, which allows the drive pulse to be fed to the capstan motor to revolve. The capstan motor, then, moves the tape a little. Motion of the tape shifts the noise position signal. When the two signals are in phase, then, the signal Q output at pin 2 on ICH08 becomes low. This closes the drive pulse gate, which inhibits the drive pulse. The result is that still picture is obtained. The drive pulse is made in the manner that the RF switching pulse is counted down by ICH08-1/2B and is shaped to a required width by ICH03-1/2B.

Frame Feed

Tape can be moved one frame by frame by depressing the FRAME FEED button repeatedly. In Fig. 3-82, depressing the FRAME FEED button triggers the monostable multivibrator (M.M.V.). This turns the phase comparator off, which makes the drive pulse gate open for a predetermined period of time. The drive pulse output of the gate revolves the capstan motor, which moves the tape. After the gate is forcibly made open, this activates frame registration circuit mentioned in the preceding section to operate. This series of operations accomplishes frame feed. Note that holding the FRAME FEED button depressed allows continuous frame feed as the drive pulse gate is kept turned on.

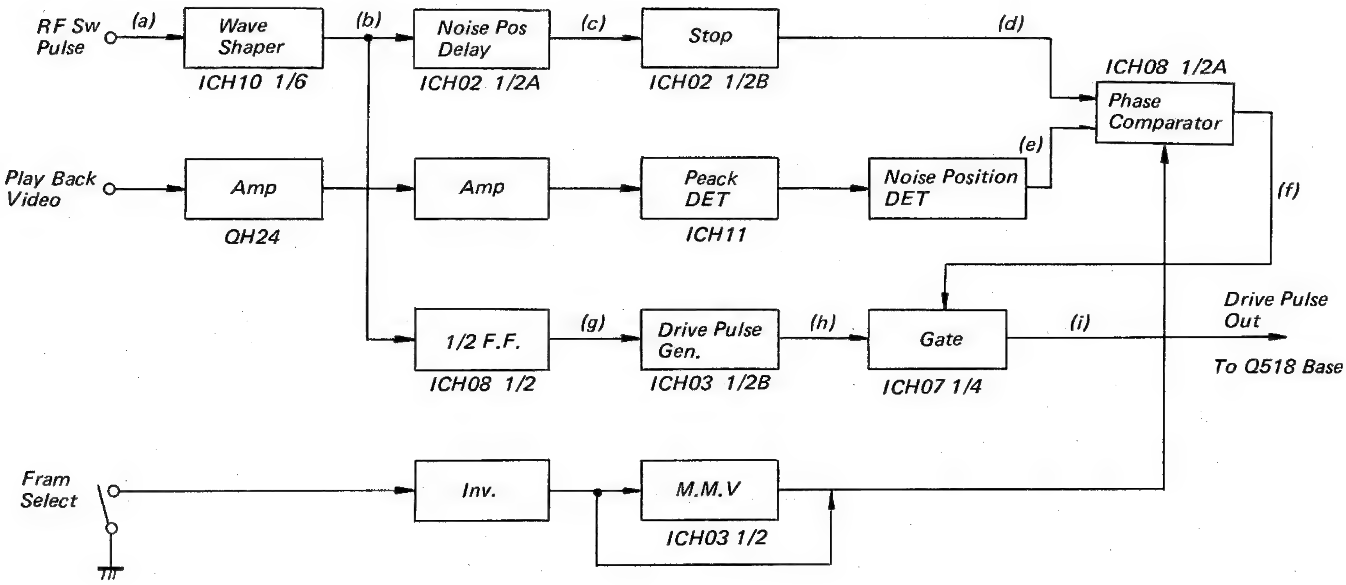


Fig. 3-82 Frame Registration Circuit Block Diagram

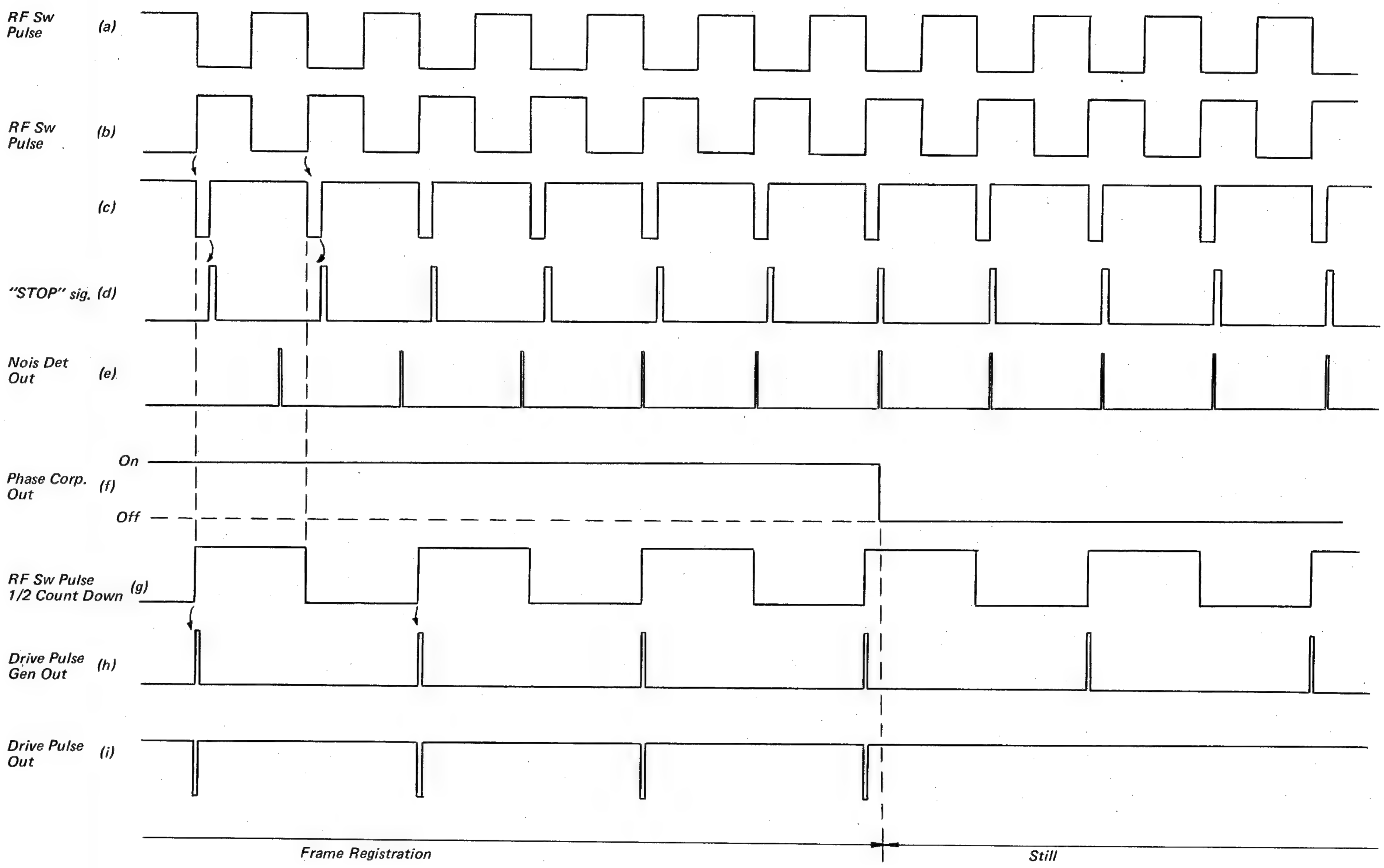


Fig. 3-83 **Frame Registration Timing Chart**

3-5-3. Noise Position Detector Circuit

The noise position detector circuit, consisting of ICH11, QH24, and QH25, produces a noise position detection signal needed for frame registration and frame feed.

A block diagram of the noise position detector circuit is shown in Fig. 3-84. In the figure, the input playback video signal is amplified through QH24 and has noise component detected by DH25 and CH26. The detected noise component is passed through the buffer amplifier QH25 to the two operational amplifiers of ICH11, where it is peak-detected. The peak-detected signal is differentiated by CH09 and RH20 to a form for use as the noise position signal, which is delivered to the frame registration circuit.

3-5-4. Pause Circuit

When in the playback or recording mode, the PAUSE switch is depressed, the pause flip-flop in ICH05-1/2 is set. In playback, the pause state is seen as the still or slow motion picture. The still signal, then, is inputted to QH14. In recording, the pause state separates the pinch roller from the capstan to stop the tape, leaving the capstan motor revolving. This assures rather prompt start of the tape when the pause state has been reset.

The pause circuit has a pause timer comprised of a 12-stage counter (ICH04) and uses a clock signal made in the manner that ICH08-1/2 frequency-halves the RF switching pulse.

When the pause flip-flop in ICH05 is set, the counter in ICH04 starts counting and in 2 minutes 40 seconds, the signal Q12 at pin 1 on ICH04 becomes high, which resets the pause flip-flop. While the pause timer operates either in recording or playback, it cannot operate in the slow motion state where the counter is cleared. Fig. 3-85 shows the pause circuit.

3-5-5. Cue and Review Tape Speed Control Circuit

In the cue or review state, this circuit controls the capstan motor so that this allows fast-forwarding or rewinding the tape as fast as 17 times the normal tape speed. Fig. 3-86 shows the tape speed control circuit.

The video tape has the 25 Hz control pulse recorded. The circuit controls the capstan motor rpm so that the control pulse may be 425 Hz, which is obtained by multiplying 25 Hz by 17, thereby providing stable tape speed.

The 25 Hz control pulse is differentiated by CH16 and RH70. The differentiated pulse is inverted and amplified through QH23, the signal output of which is integrated through CH21. The integrated signal is frequency-detected by the operational amplifier in ICH26-1/2A, the signal output of which has a duty cycle in proportion to the frequency. The otput signal is amplified through the operational amplifier in ICH 26-1/2B, the signal output of which is fed through filter to the capstan motor.

The servo circuit for the cue or review is switched over the servo circuit for the normal recording or playback mode of operation by the analogue switch in ICH27. The normal capstan servo signal is applied to pin 1 on ICH27, the signal at pin 13 of which becomes high. The high-level signal is output from pin 2.

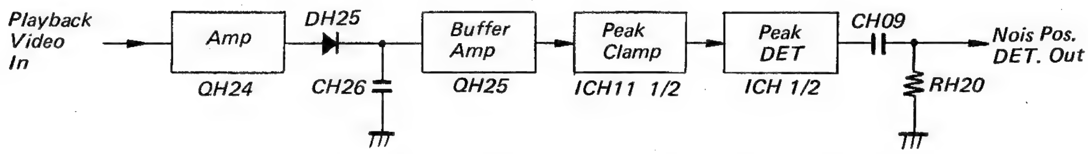


Fig. 3-84 Noise Position Detector Circuit Block Diagram

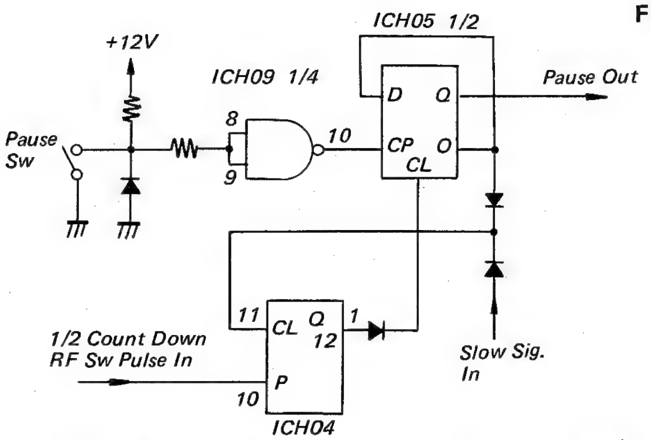


Fig. 3-85 Pause Circuit

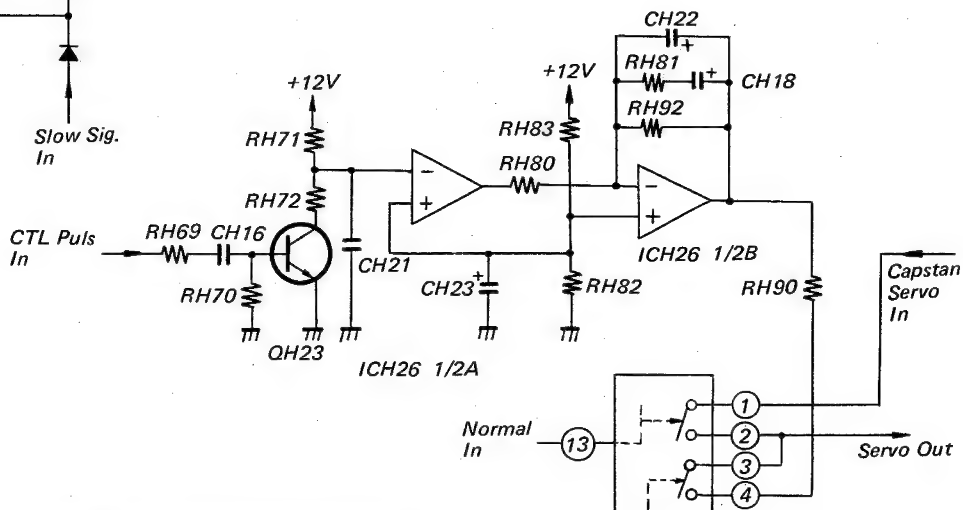


Fig. 3-86 Cue and Review Tape Speed Control Circuit

3-5-6. Other Associated Circuits

Dummy-VD Oscillator Circuit

In any of the picture search modes, including the still, slow motion, cue, and review states, the dummy-VD oscillator circuit inserts a dummy-VD pulse into the playback video signal to stabilise the vertical synchronization of the TV set. Fig. 3-87 shows a block diagram of the dummy-VD oscillator circuit and Fig. 3-88 the operation timing chart.

The noise mask pulse and dummy-VD pulse made in the dummy-VD oscillator circuit are delivered to the Video Circuit board PW2109 to be inserted into the playback video signal.

Picture Search Signal Output Circuit

In any of the still, slow motion, cue, and review states, the corresponding mode signal is output from pins 7 and 10 on PH01. The signals at pins 7 and 10, which is high in any picture search mode, is delivered to the Video Circuit board PW2109 and Audio Circuit board PW2108.

Slack Sensor Control Circuit

In cue or review, the slack sensor control circuit disconnects the slack +B line so that the slack sensor cannot function. In Fig. 3-90, QH18 is turned off in the cue or review state to disconnect the slack +B line.

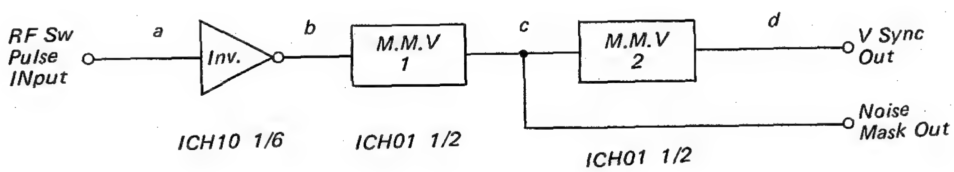


Fig. 3-87 Dummy-VD Oscillator Circuit Block Diagram

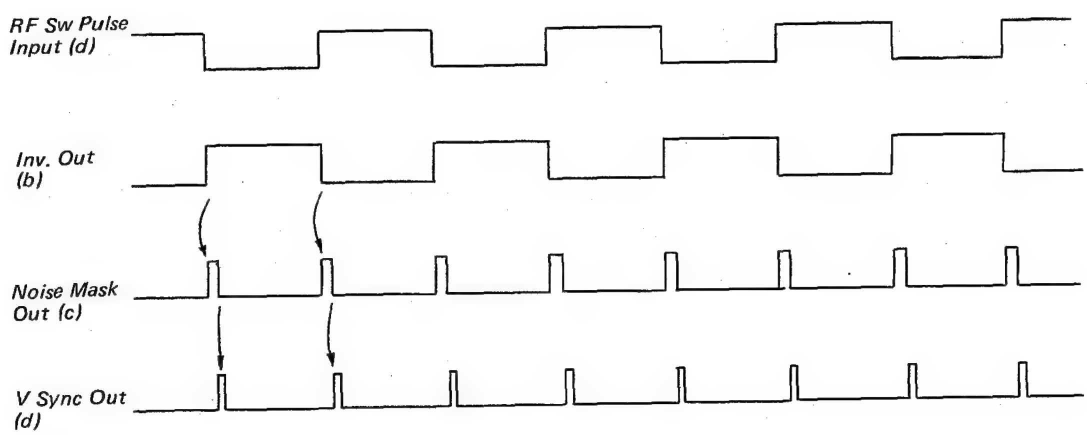


Fig. 3-88 Dummy-VD Oscillation Timing Chart

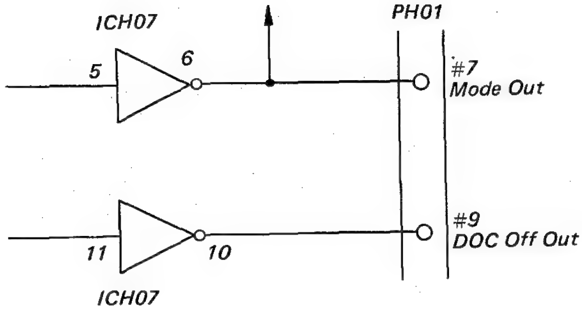


Fig. 3-89 Picture Search Signal Output Circuit

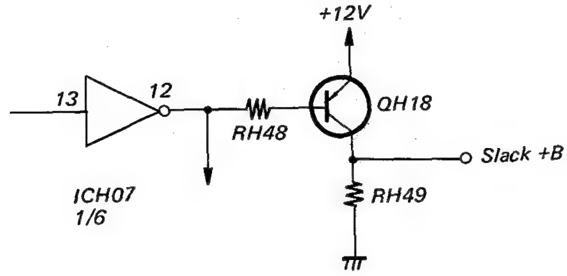


Fig. 3-90 Slack Sensor Control Circuit

Fast-Forward/Rewinding Control Circuit

If the FF or REW button is depressed, Q517 and Q522 in the Servo and Logic Circuit board PW2110 are turned on. This connects the 12 V +B through Q518 to the capstan motor, which revolves at a high speed. In review or cue playback, Q518 is kept turned off as the capstan motor is servo-controlled for constant tape speed. In Fig. 3-91, QH13 is turned on to ground the base of Q517.

Counter Memory Control Circuit

In review playback, the counter memory control circuit stops the function of the counter memory. In Fig. 3-92, QH12 is turned on to turn the counter memory off.

Tape Sensor Control Circuit

In review playback, the tape end sensor control circuit stops the fast-forward tape end sensor oscillator, but keeps the rewinding tape end sensor oscillator in operation. In Fig. 3-92, QH20 is turned on to lower the bias of the rewinding tape end sensor oscillator circuit to stop.

Audio Output Amplifier Circuit

The audio output amplifier QH19 in Fig. 3-93 magnifies the audio signal from the Audio Circuit board PW2108 by 4 dB, approximately, which is led to the Antenna Terminal board.

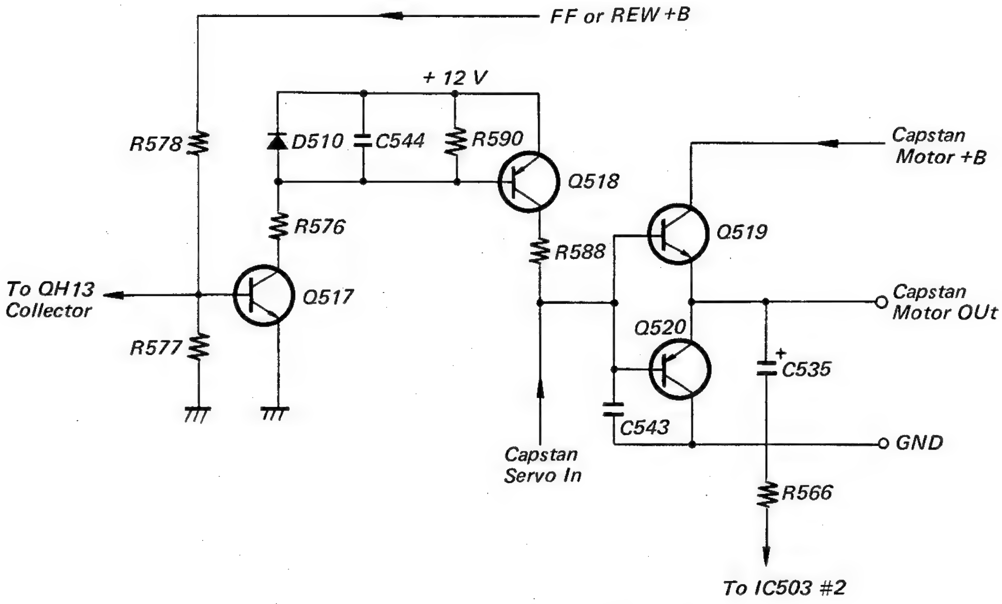


Fig. 3-91 Capstan Motor Drive Circuit

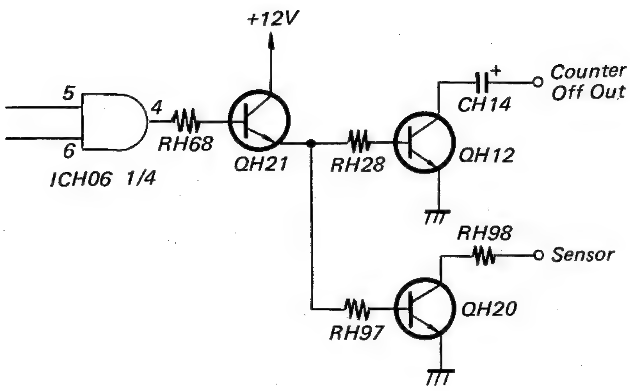


Fig. 3-92 Counter Memory and Tape Sensor Control Circuit

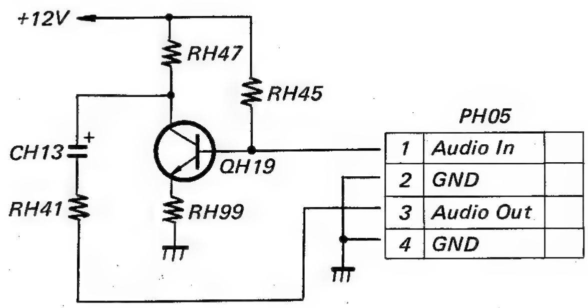


Fig. 3-93 Audio Output Amplifier Circuit

3-5-7. Servo-Use Clock Oscillator Circuit

The reference clock oscillator circuit for use with the servo circuit is located on the Disk Drive Circuit board PW2115. In the normal recording or playback mode or still or slow motion state, a crystal-controlled oscillator produces a stable reference clock pulse. In the above-mentioned mode of operation, Q966 in Fig. 3-94 is turned on to make Q965 form the crystal-controlled oscillator.

In cue or review, the tape speed is considerably different from the normal recording or playback speed as described previously. This causes deviation of the relative speed of the tape to the video heads as much as 5%, approximately, if the tape is played back at the normal speed of the video disk. The result is that the horizontal sync pulse frequency of the playback video signal deviates 5% from the rated frequency. The horizontal scanning of the TV set, therefore, could fail to synchronise. To prevent such a failure, the video disk speed is compensated in the cue or review state, respectively, in the manner that the frequency of the clock oscillator for the servo circuit is changed. Changing of the oscillation frequency is made by switching the normal crystal-controlled oscillation to an LC oscillation. In cue or review Q966 is turned off to disconnect the crystal. In cue, Q968 is turned on and in review, Q967 is turned on. These allows the oscillator to produce clocks at frequencies predetermined in terms of Z962 and Z961, respectively.

The signal output of the oscillator Q965 is magnified through the output amplifier Q964 and is delivered to IC501 on the Servo and Logic Circuit board PW2110.

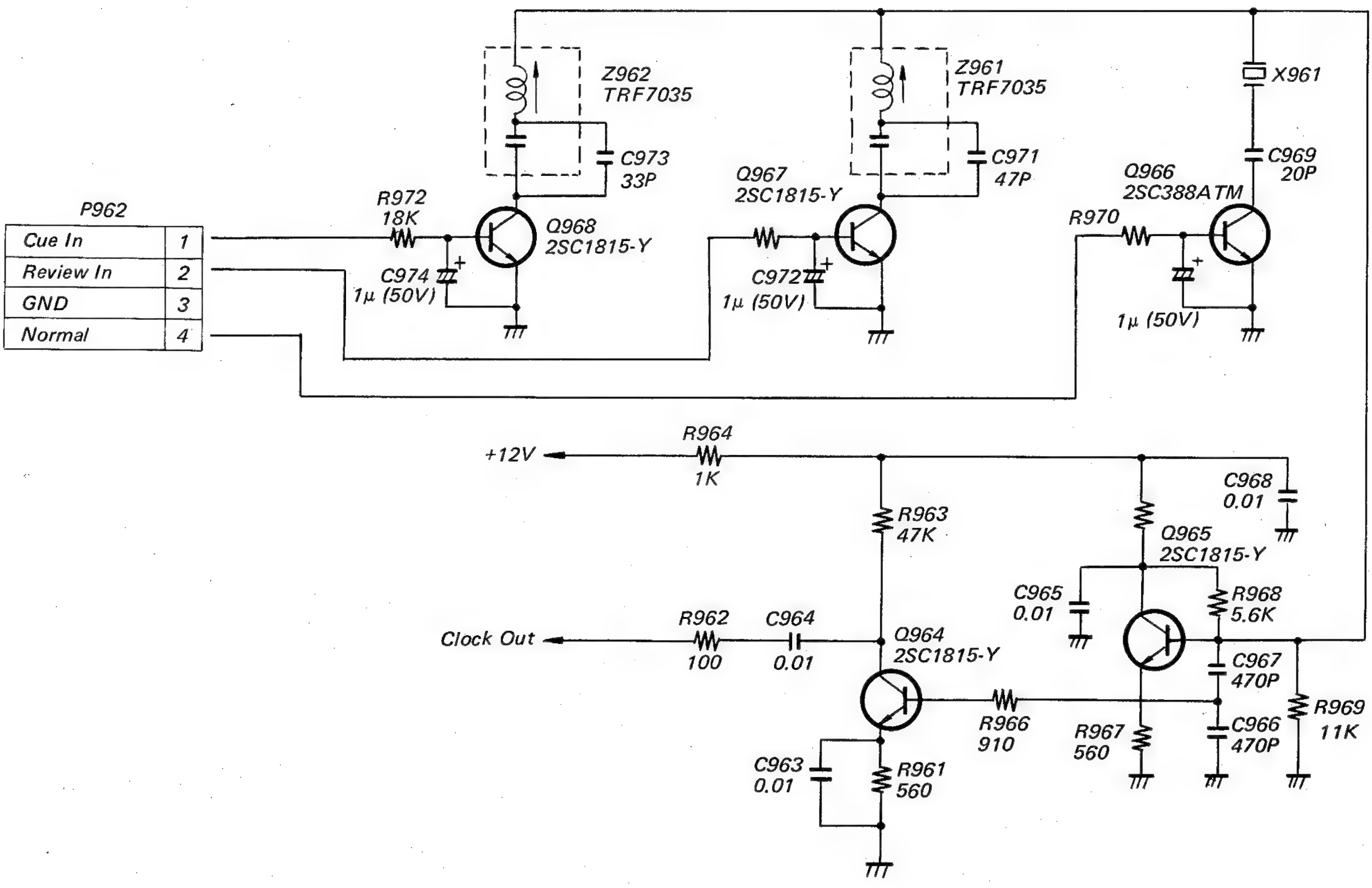


Fig. 3-94 Servo-Use Clock Oscillator Circuit

3-6. PROGRAMME TIMER SYSTEM

3-6-1. Programme Timer Circuit, PW2112

General

The Programme Timer Circuit PW2112 is a quartz-locked digital programmable timer using a C MOS LSI TC5038P which provides a capability of reversing three programmes for a week. It has three memories, a liquid crystalline display, and a clock with use of a 32.768 kHz crystal-controlled oscillator. The LSI is of flat package type, having as much as 5,000 elements and 67 pins. Reserving desired three programmes can be accomplished in a weekly cycle manner by setting the hours, minutes, days of the week, and channels. If the days of the week are not designated, recording is automaticallys started or stopped in time in the 24-hour cycle manner that a programme is recorded in the same time and same channel everyday. One of the two above-mentioned recording cycle types can be selected individually for each programme. In the following section will be described in what manner that Programme Timer Circuit operates and is manipulated.

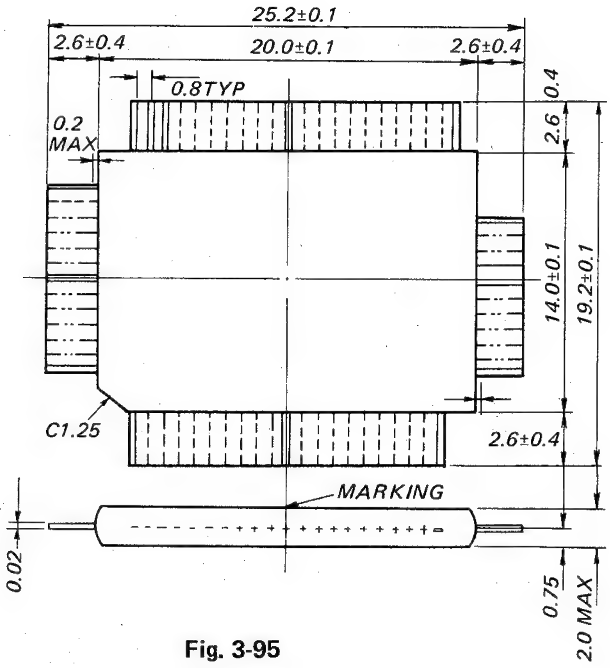


Fig. 3-95

Clock Operation

The clock indicates a current time in the 24-hour digital system and the day of the week in characters. Note that only the characters of a current day is illuminated, but those of the other days are not shown. The time indication is carried up as shown in Table 3-1.

The clock is controlled by the reference signal of 32.768 kHz that is generated by IC861 (TC5038P) having the crystal-controlled oscillator with the crystal X861, C864, and C865. IC861, then, produces drive signals for the liquid crystalline display G861, which indicates the current time and day.

The clock is operated when the +B voltage is supplied to the Programme Timer Circuit board with the power cable is plugged into a wall outlet and Mains switch at the rear of the VTR is turned on, irrespective of the position of the Function switch S981. At the same time, power is applied to the liquid crystalline illuminating lights G862 and G863, which are on at all times. The lights enables the liquid crystalline display to be visual without room light because it cannot emits light by itself.

The Programme Timer Circuit serves for clock and timer operations when the TIME ADJUST/TIME/PROGRAMME switch S861 at the front panel is in the TIME position.

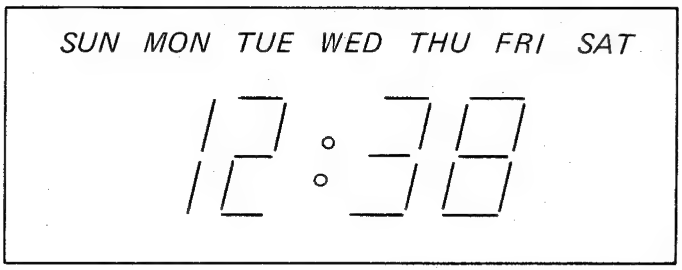


Fig. 3-96

DAY	TIME
SUN	23:59
MON	0:00
	0:01
	↓
	0:59
	1:00
	↓
	9:50
	10:00
	11:59
	12:00
	↓
	12:59
	13:00
↓	↓
MON	23:59
TUE	0:00
↓	↓

Table 3-1 Carry-up Display

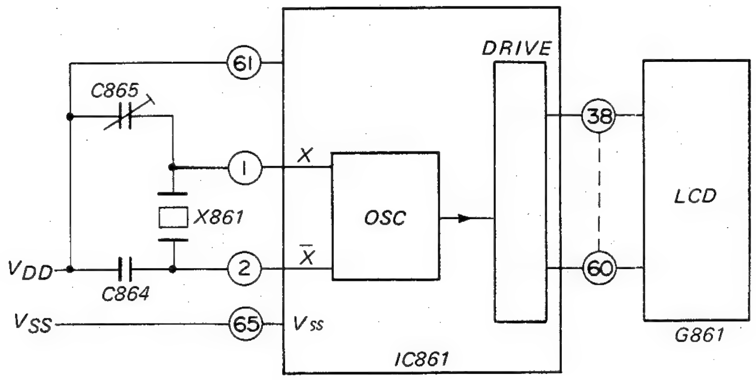


Fig. 3-97 Crystal Oscillator Circuit

Setting the Clock

To set the clock to a current time, first throw the TIME ADJUST/TIME/PROGRAMME switch S861 to the TIME ADJUST position. In this position, the clock stops and can be set to the correct time (see Fig. 3-98). For correcting the timer indication, use the Programme Set buttons at the front panel (see Fig. 3-98). In general, correction should be in the order of the MINUTE set button S863, HOUR set button S862, and DAY set button S864. It, however, may be started with any of the buttons.

In clock adjustment, care should be exercised in the carry-up of each Programme Set button (see Table 3-2). Note that in clock adjustment, the CHANNEL Set button is ineffective.

Correction of the clock indication is performed in the manner that the digits to be corrected, for example, the HOUR digits, are designated and at the same time, a step signal is applied to pin 13 of IC861. Each Programme Set button advances the time one digit whenever depressed for shorter than one second, but is capable of quickly moving it by depressing for longer than one second. The clock is held at the indicated time while the switch S861 is in the TIME ADJUST position. It starts clock action when the switch is set to the TIME position. It, therefore, can be set precisely to a second order by turning the switch to the TIME ADJUST position just when the time signal is heard. Note that when the switch is in the TIME ADJUST position, all of the Programme Set buttons are not effective.

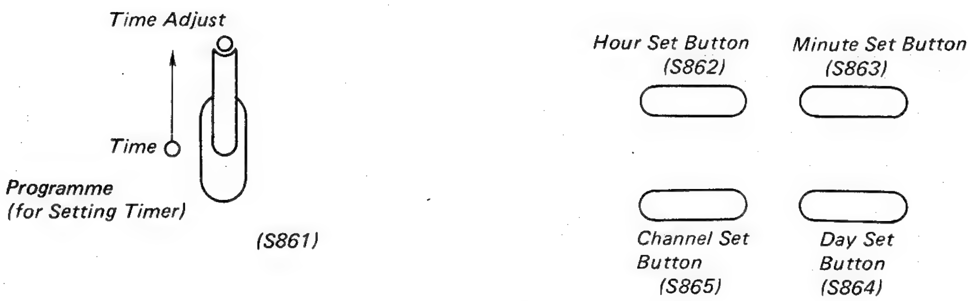


Fig. 3-98 Programme Set Buttons

MINUTE Set button S863	Minute digit addition → Hour digit addition → Day character change.
Hour Set button S862	Hour digit addition → Day character change.
DAY Set button S864	Day character change only.

Table 3-2 Carry-up by Programme Set Buttons

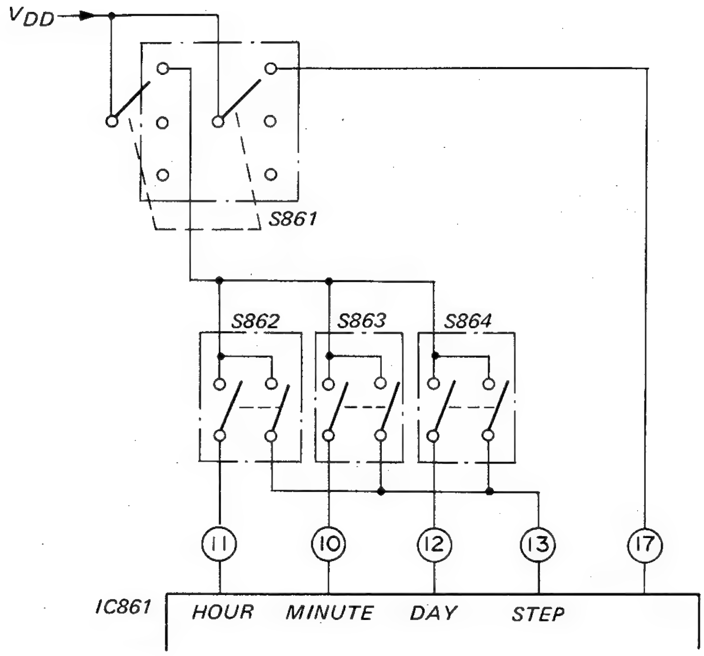


Fig. 3-99 Setting Clock

Channel Position No.	CODE			
	CH A	CH B	CH C	CH D
OFF	0	0	0	0
1	1	1	1	1
2	0	1	1	1
3	1	0	1	1
4	0	0	1	1
5	1	1	0	1
6	0	1	0	1
7	1	0	0	1
8	0	0	0	1
9	1	1	1	0
10	0	1	1	0
10	1	0	1	0
10	0	0	1	0

Table 3-3 Channel Output Code

Programme Timer Operation

IC861 has three timer output pins corresponding to the three programmes. Each output pin is turned on or off according to the respective preset instances. IC861, also, has a set of channel output pins by which a desired channel can be designated among from the 10 channels. The channel output pins are interlocked with and provided for each timer output signal.

Each timer output signal ST can be independently set either to the weekly cycle or 24-hour cycle mode. The timer output is at a high level when it is on or at a low level when off.

Each channel output signal is representated by a 4-bit pulse code shown in Table 3-3. All bits of the pulse code is at a low level ('0') when the timer output is off. Each channel number is designated in a specific combination of the four bits output when the timer output is on. IC861 provides a capability of setting any of channel positions 1 through 10.

If the two or three timer outputs are overlapped in the channel outputs, these are automatically switched on or off according to priority as illustrated in Table 3-4 and Fig. 3-102.

Pin 67 of IC861 turns off all the timer outputs and channel output unconditionally when it has the timer stop signal V_{DD} applied, as illustrated in Fig. 3-104. The timer stop signal comes in at all times when the Function switch S981 is in the FUNCTION or STAND-BY position. Note that even if the timer stop signal is reset, the timer outputs are held off until the next timer-on. While the Function switch is in the TIMER position, the operating power is turned on or off according to the stored programme irrespective of the functional buttons on the VTR body.

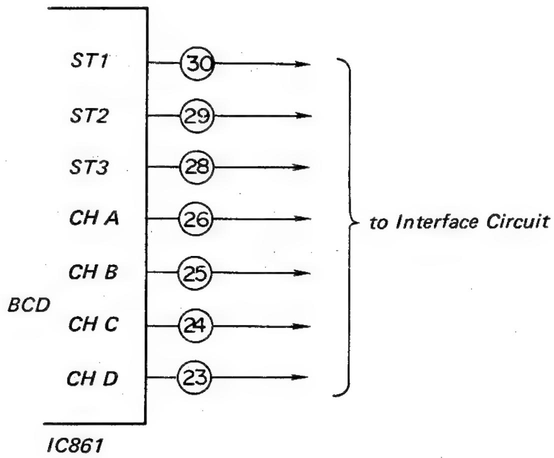


Fig. 3-100 IC861 Output Pins

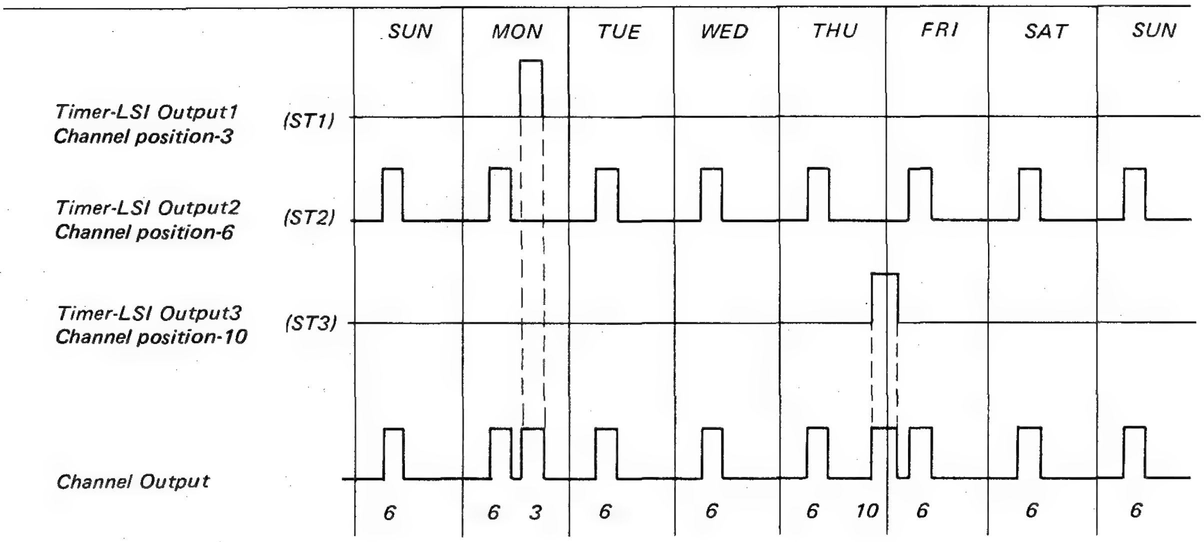


Fig. 3-101 Timer LSI Output & Channel Outputs

Channel set in LSI timer output 1.	>	Channel set in LSI timer output 2.	>	Channel set in LSI timer output 3.

Table 3-4 Priority of Channel Outputs.

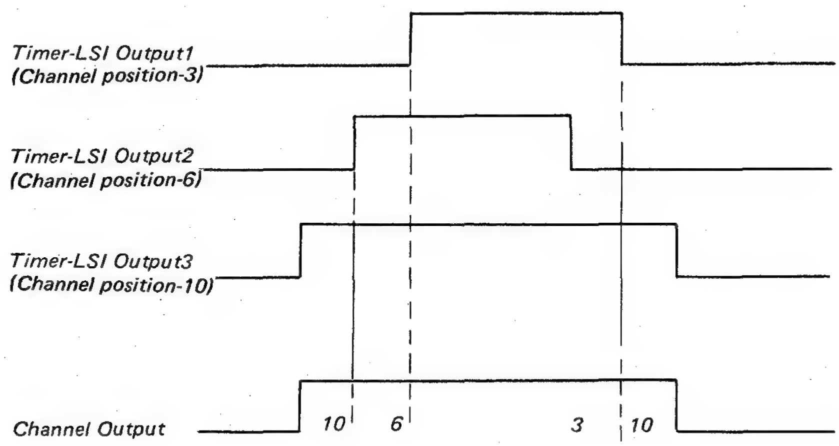


Fig. 3-102 Channel Output Series According to Priority

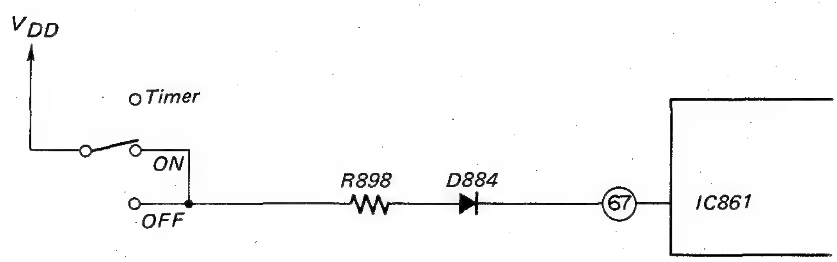


Fig. 3-103 Timer Stop Signal

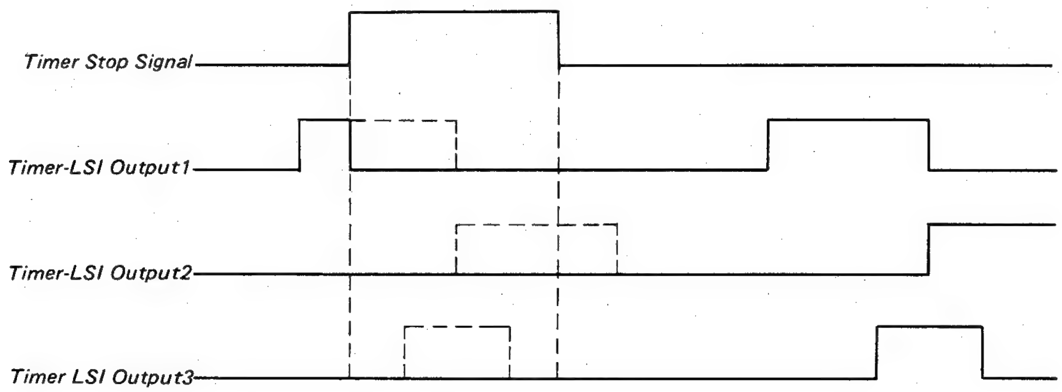


Fig. 3-104 Timer Stop Signal which Turns Off & Timer Output

Setting the Programme Timer (for Programme Reservation)

This section describes how to enter start and stop times of three desired programmes and channel numbers. First, throw the Function switch S981 to the POWER position. Second, set the TIME ADJUST/TIME/PROGRAMME switch S861 to the PROGRAMME position, by which the liquid crystalline display G861 will change in the indication. This shows the contents of the memory as specified by the PROGRAMME MEMORY switch S866 (see Fig. 3-105). The indication of the liquid crystalline display G861 can be changed by turning the switch S866. The channel output, also, is changed according to the entered channels 1, 2, and 3.

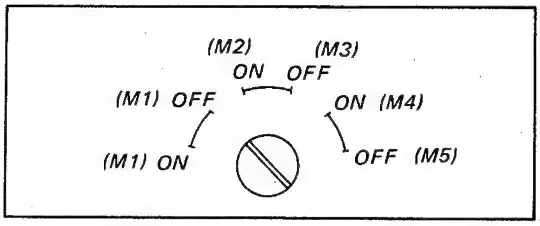


Fig. 3-105 Programme Memory Switch

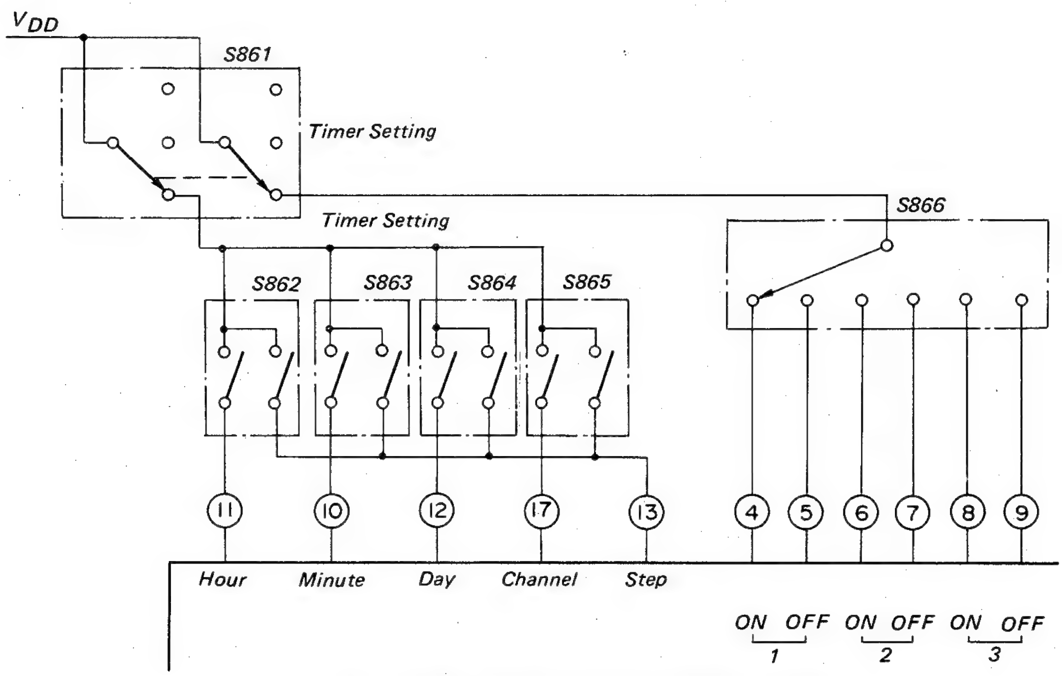


Fig. 3-106 Programme Timer Setting Circuit

Then, set the PROGRAMME MEMORY, switch S866 to positions one by one in connection with desired programme start and stop times. This designates the memory that is to be corrected in IC861.
Now, proceed with memory correction in a way similar to that of Section "Setting the Clock", as directed below. Depress either of the MINUTE button S863 or HOUR button S862. This will turn off the day indication on the liquid crystalline display and sets programming in the 24-hour cycle mode. Adjust the minute and hour indication of the desired programme start and stop times using the MINUTE and HOUR buttons. This accomplishes the programme entering that enables recording of the programme to start in the same times everyday in the 24-hour cycle mode.
Refer to Fig. 3-107.
To designate the channel of the desired programme, depress the CHANNEL button S865 after the PROGRAMME MEMORY switch S866 is set. Note that if the different channels are entered in the ON and OFF positions of the PROGRAMME MEMORY switch, the channel designated at the time of the ON or OFF position to which the switch is set after, is entered in the memory.

After completion of the minute and hour setting, a desired day of the week may be entered using the DAY Set button S864. This makes the liquid crystalline display G861 indicate the day of the week and changes programming to the weekly cycle mode. For the weekly cycle mode of programming, be sure to enter the day of the week when the PROGRAMME MEMORY switch is set in any of the ON and OFF positions. If it is entered for one of the two positions, but not for the other, this causes an errorneous programming.
IC861, as mentioned previously, has a channel drive circuit and channel indication circuit. The channel drive circuit is turned off by the timer stop signal, being interlocked with the timer outputs. The timer indication circuit, which is activated by the CHANNEL Set button S865, not by the timer stop signal, allows the channel number to be entered, or reserved for, to indicate. The channel drive signal and channel indicating signal are representated by 4-bit code each.
After completion of the programming, turn the PROGRAMME MEMORY switch S866 successively to check the entered programme start and stop times and channel numbers, leaving the TIME ADJUST/TIME/PROGRAMME MEMORY switch S861 in the PROGRAMME position. Then, return the switch S861 to the TIME position. This completes all the programming procedures.

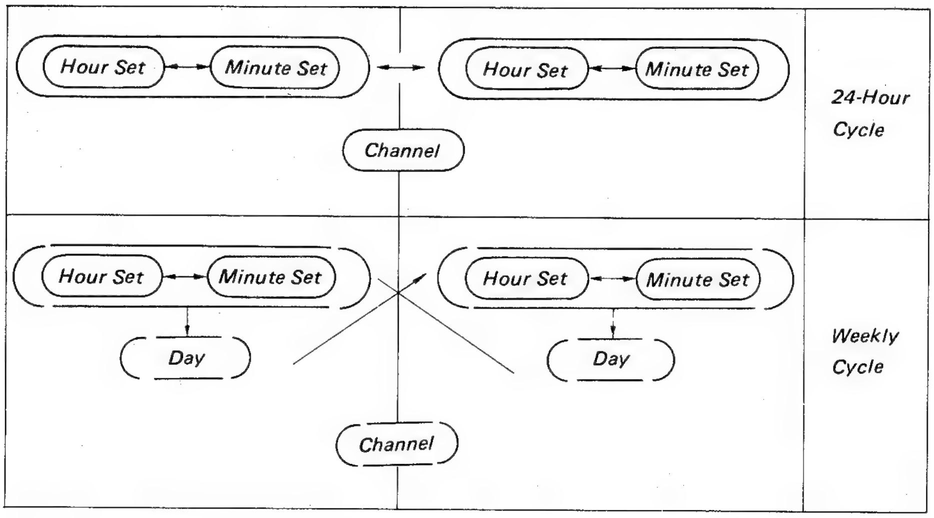


Fig. 3-107 Programme Cycle Modes

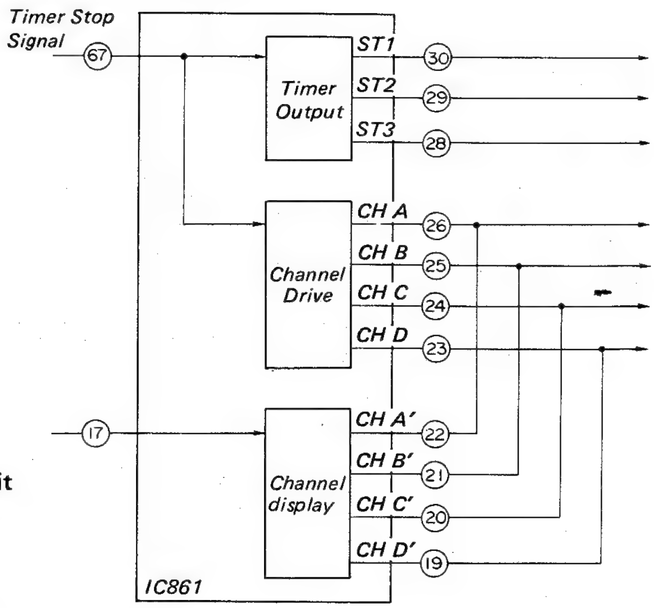


Fig. 3-108
Channel Designating Circuit

Liquid Crystalline Display

The liquid crystalline is in the liquid state as the matter, but provides a property of solid like a crystalline from the stand of optical view. The liquid crystalline is used for character display as described below (see Fig. 3-109).

A transparent electrode plate and glass plate are put on the upper and lower sides of the liquid crystalline layer each as shown. Outside of each transparent electrode plate is fitted to a polarizing plate. The liquid crystalline molecules are arranged in parallel with the transparent electrodes plate so that the liquid crystalline molecules should be twisted 90 degrees in the space between the upper and lower electrodes. The two polarizing plates, also, are directed so that their planes of polarization should be 90 degrees to each other.

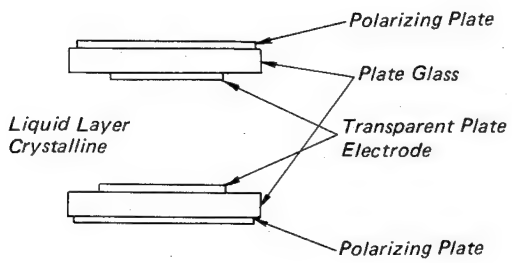


Fig. 3-109 Structure of Liquid Crystalline Display

In the state shown in Fig. 3-110 where no voltage is applied between the polarizing plates 1 and 2, the light is polarized in the arrow direction as passing the polarizing plate 1. The light plane of polarization is rotated 90 degrees in the liquid crystalline cells. The rotated light passes the polarizing plate 2. If rather higher voltage than (V_{th}) s applied between the transparent plate electrodes as in Fig. 3-110, then the liquid crystalline molecules are aligned in the direction of electric field. This means that the light plane of polarization cannot be changed in the direction. The result is that the light passing the polarizing plate 1 reaches the polarizing plate 2 directly, but cannot pass this, therefore, the surface of the polarizing plate 2 looks dark as seen upward it.

The liquid crystalline display is activated in a dynamic drive method employed in IC861. In the method, activation of the segments of each digit is time-divided, resulting in use of rather small number of drive circuit pins. If a DC voltage is used for the opposite transparent plate electrodes, this causes an electrochemical reaction which would shortens the working life. To avoid this, IC861 uses an AC voltage of 32 Hz, approximately, higher than Vth. Each of the 32 Hz liquid crystalline drive signals fed from the two common pins, COM-1 (pin 59) and COM-2 (pin 60) of IC861, is applied to one of each pair of the transparent plate electrodes. Each segment pin applies the other end of the signal to the other of the pair. Note that a single segment pin activates two segments. When the voltage between the electrodes is higher than Vth, the character appears.

Refer to Fig. 3-111.

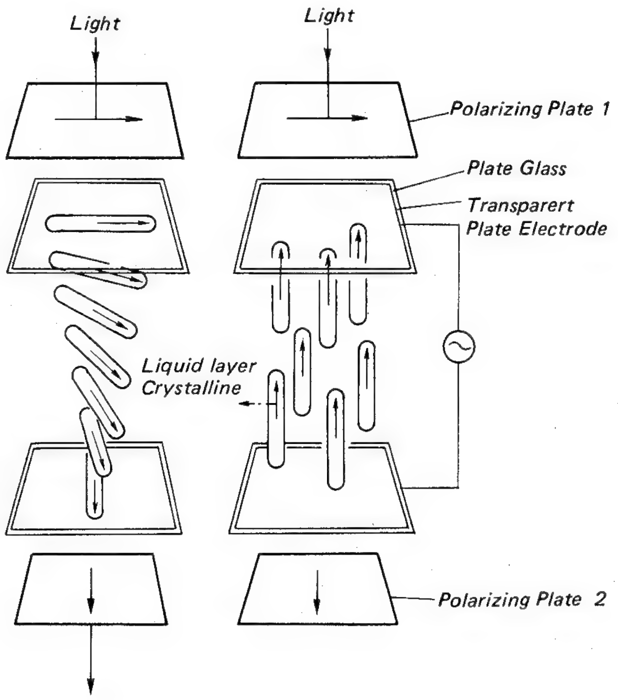
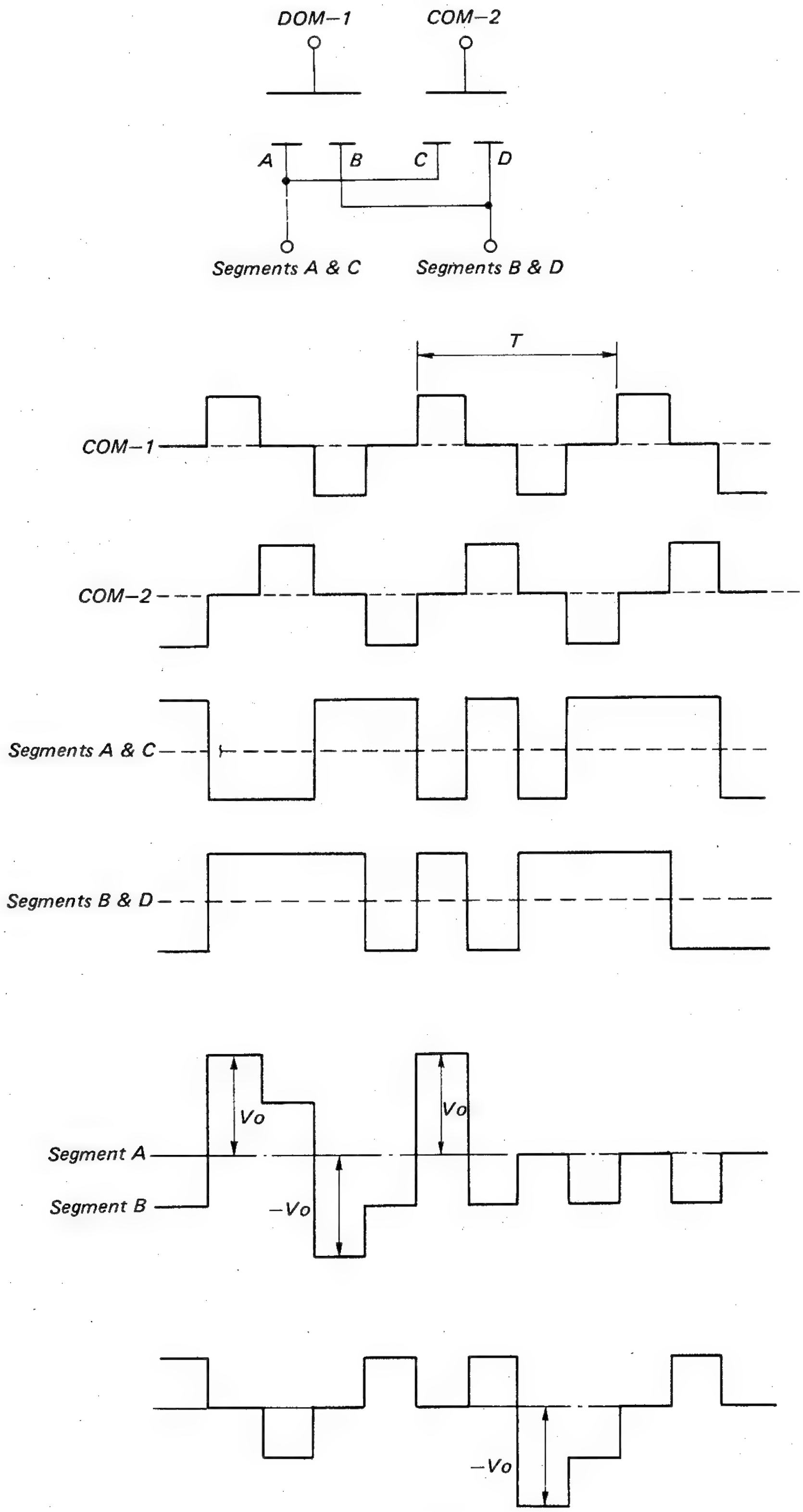


Fig. 3-110 Principle of Liquid Crystal Display



Vo′ – Vo : Activation Voltage > V th

$f = \frac{1}{T}$: Activation Signal Frequency of 32 Hz

Fig. 3-111 Programme Timer Timing Chart

3-7. TUNER SYSTEM

General

The Tuner Block consists of an Antenna Terminal Board, a Tuner IF-AMP, a Selector Circuit, a PIF and SIF Circuit, and a Modulator Circuit. The operation of the Tuner Circuit is as follows.

The incoming signal induced in the AERIAL (VHF/UHF) is converted to stable video and audio signals. Instead, the signal from a Video camera or similar video equipment may be fed to the Video and Audio Circuits. In the playback or monitoring mode, the signals of the Video and Audio Circuits, may be either fed out directly to video equipment, such as monitor TV set, or converted to composite TV signal (RF wave) in a E31 ~ 39 channels to receive by a usual TV set.

Antenna Terminal Board

Previous VTRs have a splitter that divides into two routes the RF signal received by the antenna. This results in reduction of the RF signal strength both for the VTR and TV set. To overcome such an undesirable effect, the present V-5470 has a new wideband booster of +4 ± 3 dB gain. The booster shown in Fig. 3-113 serves together with an attenuator to prevent the signal output of the RF modulator and the signal of the local oscillator in the built-in Tuner from leaking to the antenna as well as to compensate the gain of the input RF signal.

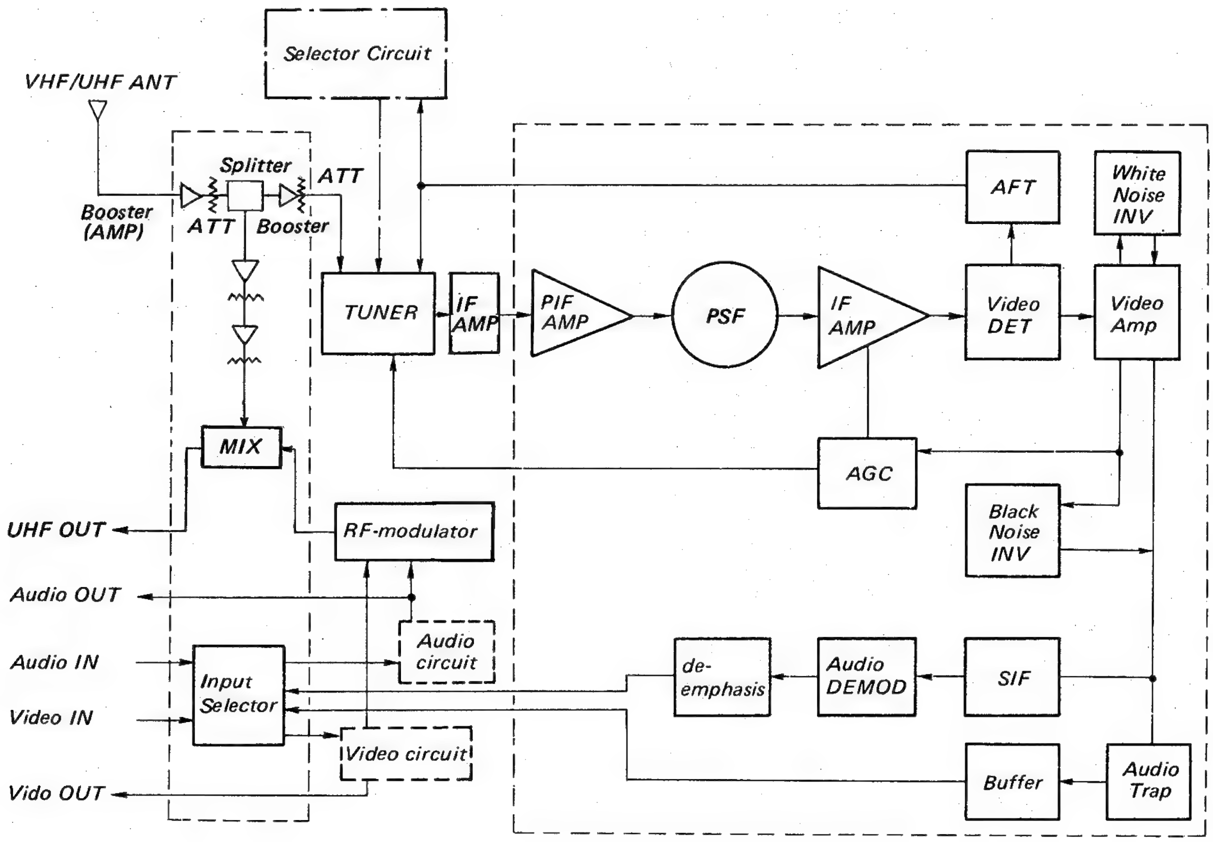


Fig. 3-112 Tuner Block Diagram

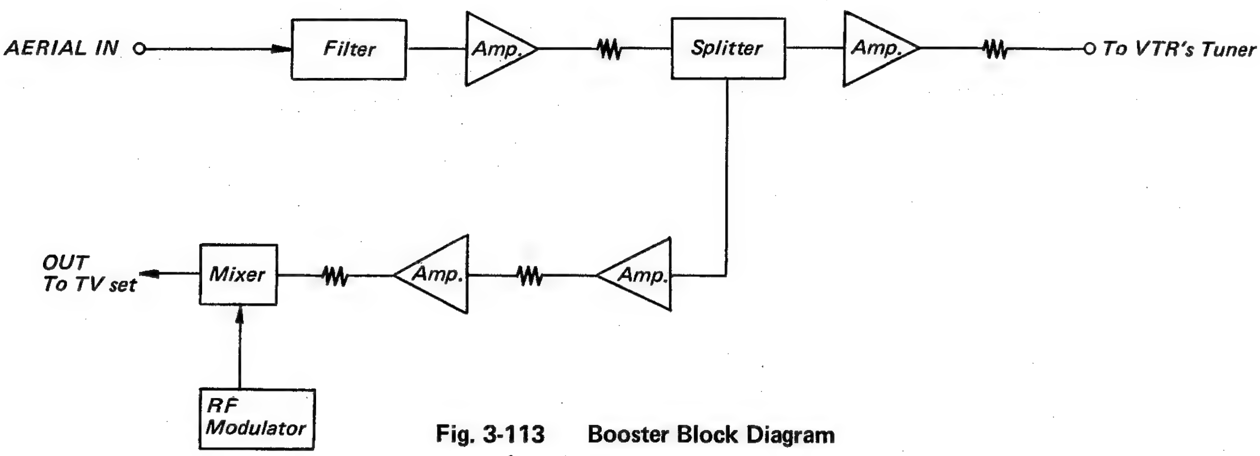


Fig. 3-113 Booster Block Diagram

Electronic Tuner, PIF, and Selector Circuit

Description of the Varactor Diode

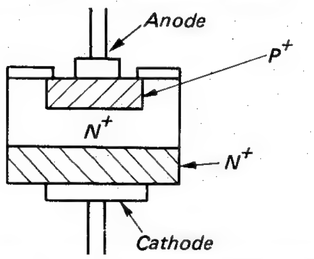


Fig. 3-114 Varactor Construction.

The varactor, as illustrated in Fig. 3-114, is a PN junction diode characterized by a voltage-sensitive capacitance. In the figure, P+ is a region where a trivalent impurity is doped in bulk, and N a region where a pentavalent impurity is doped little. If a reverse bias is applied to the varactor, or if a negative voltage is connected to the anode and a positive voltage to the cathode, an electric double layer called the "depletion layer" having no mobile carrier charge is forward at the junction between P+ and N. The capacitance of the imaginary capacitor formed by the charges of the depletion layer can be varied as a function of the reverse bias.

The equivalent circuit of the varactor is shown in Fig. 3-115. In general, RN > Rp+ and RN > RN+. Also, RN is high with the capacitance. The varactor made of silicone variable in the capacitance from 2 pF (30 V) to 12 pF (3 V) has RN around 0.5 Ω at maximum. A usual variable capacitor, the equivalent circuit of which is represented by C and R in series, has R around 0.01 Ω involved mainly in the rotor contact. Such a high RN as compared with R of the variable capacitor is one of most important difficulties affecting the characteristics of the varactor, particularly in inhibiting high Q of the tuning circuit. High sensitivity cannot be obtained by the tuning circuit, but a proper NF and gain are obtained.

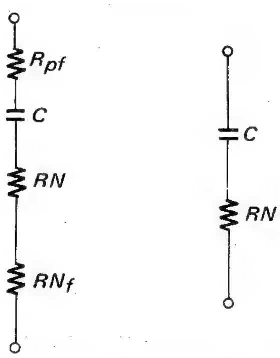


Fig. 3-115 Varactor Equivalent Circuit.

PIF Circuit

The IF signal entered from PB04 on the Selector Circuit board PW2139 is amplified around 18 dB by the ground-emitter IF amplifier Q001. L001 and R001 are placed to make the input impedance to 75Ω at the center frequency fo to minimize response change due to the IF cable. L002 is tuned at a frequency with the input capacitance of the surface acoustic wave filter, which will be described in the following paragraphs, to make the IF amplifier frequency response rather flat. C003 blocks the flow of the DC current to the surface acoustic wave filter. The IF amplifier is placed to compensate for the insertion loss of the surface acoustic wave filter.

The surface acoustic wave filter serves to pass the signal in the IF band, to trap the signals in the adjacent channels 2.0 MHz above and 8 MHz below the picture carrier frequency, and also to trap the audio signal at 6.0 MHz below. The surface acoustic wave filter needs no alignment and is improved in the reliability and reduced in the number of parts used as compared with the conventional filters comprised of inductors and capacitors.

The surface acoustic wave is similar to the wave propagation caused on water surface, such as a pond, when a stone is thrown in. The surface acoustic wave propagates on the boundary between an elastic and air, or on the surface of the elastic.

The surface acoustic wave filter is illustrated in Fig. 3-116. As shown in the figure, an input and output inter-digital transducers are put on piezoelectric substrate. If a AC voltage is applied to the input transducer, an AC electric field is produced between the electrodes of the input transducer on the surface of the substrate. The electric field causes a mechanical expansion and contraction, or an elastic strain. The strain energy is concentrated and propagates rightly under the surface of the substrate. The propagating waves are summed up and received by the output transducer.

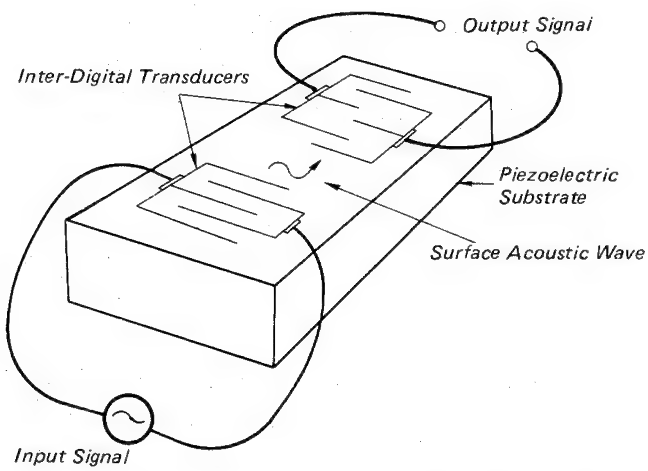


Fig. 3-116 Surface Acoustic Wave Filter Structure.

The propagation velocity of the surface acoustic wave denoted by Vs is determined in terms of the substrate characteristics and crystal structure. The amplitude is in proportional to the strength of the electric field produced by the input voltage and of the distance between the two transducers. The center frequency denoted by fo is given by

$$fo = \frac{Vs}{\lambda}$$

where λ is the interval of the inter-digits of the transducer. The amplitude of the surface acoustic wave produced by a pair of opposite digits is in proportion to the interpolation of the digits. The phase of the acoustic wave depends on the positions of the digits.

The bandwidth of the filter is narrow and the impedance is low with increase of the number N of pairs of opposite digits as this increases the stress by signals around the center frequency. The frequency response of the filter is determined in terms of the product of those of the two transducers, or the exciting (input) transducer and receiving (output) transducer. If the receiving transducer has a few inter-digits, the frequency response of the filter depends to a high degree on that of the exciting transducer.

The surface acoustic wave filter (hereinafter referred to as "PSF filter") is designed so that its center frequency should be around 37 MHz and the bandwidth is selected to minimize the adjacent video and audio frequency responses. These are achieved by properly determining the interval and number of the digits of the exciting transducer and by making flat the frequency response of the receiving transducer having a few digits.
As shown in Fig. 3-117 below, the signal passed the PSF filter enters pins 1 and 16 on IC002 (TA7607AP) and is magnified 57 dB by the IF amplifier, consisting of three differential amplifier stages. The IF amplifier can be gain-controlled up to 63 dB as a succeeding stage controls the gain of the preceding stage in sequence, thereby providing good signal-to-noise ratio. The IF amplifier, also, has a DC feedback from the output to the input to minimize undesired offset in the differential amplification.

The amplified PIF signal is taken out and routed by the emitter follower into the "and" circuit, or the multiplier, and through the other emitter follower the **differential amplifier having the 38.9 MHz tuning** network and limiter as loads. The limiter restricts the signal to produce the video carrier of a constant amplitude. The video carrier is led as a switching signal to the "and" circuit. The "and" circuit homodyne-detects the video signal from the PIF signal with use of the switching signal. The video signal is magnified by the grounded-base amplifier and is fed out through the emitter follower.
Also, the switching signal is divided into two parts: one is directly led to and the other through an external 90° phase shifter to the other "and" circuit. This "and" circuit produces a DC voltage that corresponds to the frequency difference between the two signals. The DC voltage is magnified for use as the AFT voltage.

In addition to the above-mentioned functional circuits, the PIF IC (TA7607AP) contains a black noise inverter and white noise inverter that cut out undesired noises to clamp to certain levels as illustrated in Fig. 3-118.

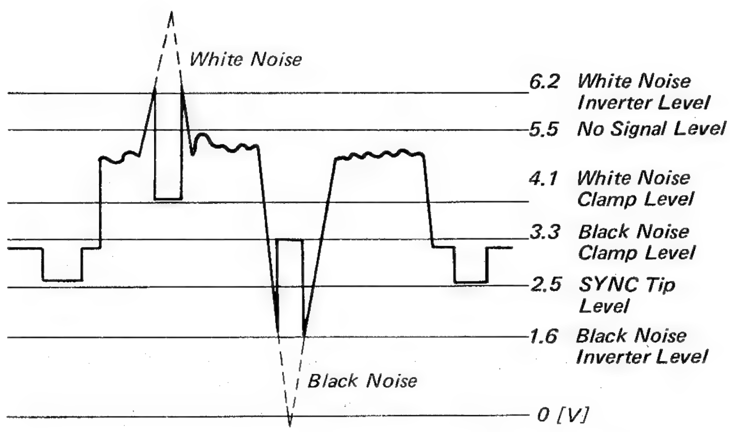
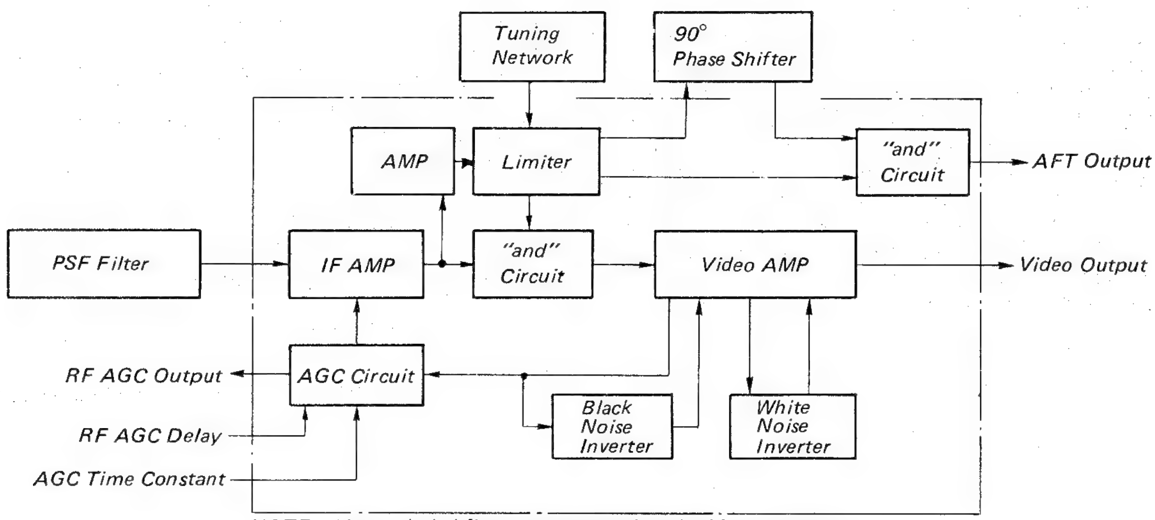


Fig. 3-118 Noise Clamp Levels.



NOTE: The encircled figures correspond to the IC pin numbers.

Fig. 3-117 PIF IC (TA7607AP) Block Diagram.

The video signal fed out from pin 12 of the PIF IC is divided into two parts: one passed the 5.5 MHz audio trap to eliminate the audio signal and is output by the emitter follower having 75 Ω output impedance; and, the other passes the 5.5 MHz ceramic bandpass filter and is fed to the Audio Detection IC003 (TA7176AP). In the Audio Detection IC, the SIF signal is limited and amplified by three differential amplifier stages and passes the low pass filter which eliminates the harmonic components to improve the AM suppression ratio. The SIF signal, in turn, is divided into two routes: one is directly connected to the input of the differential amplifier and the other to the phase shifter, comprised of a ceramic filter, where the signal is phase-shifted 90° and also is fed into the differential amplifier. As the SIF signal is deviated from 5.5 MHz, the signal passing the phase shifter deviates more than 90°. This deviates the turn-on and turn-off periods of time, that is, the audio signal is frequency-detected.

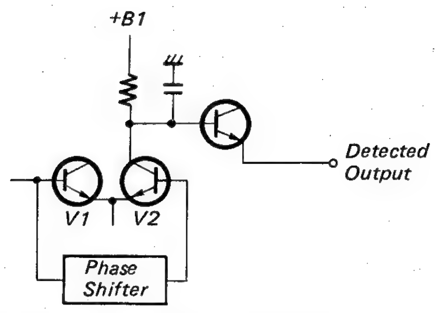


Fig. 3-119 Differential Amplifier Circuit.

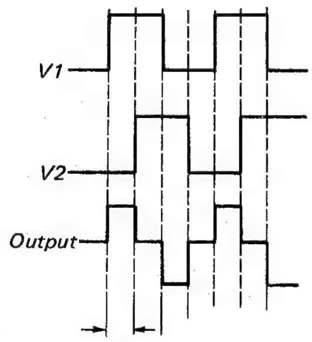


Fig. 3-120 Differential Amplifier Time Chart.

Selector Circuit

The Electronic Tuner, as described the "VHF Tuner Section", is controlled by DC voltage to tune into a desired channel. If the DC voltage is stored for each channel, the tuner can be turned into it at any time by depressing the button corresponding to it. The DC voltage may be stored as it is, but this is not reliable as it is set in a variable resistor and the like. It is desired therefore that the analog value of DC voltage continuous variation is converted to digital value which assumes one of the two stages, "1" or "0", only. The digits can be stored semipermanently as the electrical signal, by turning on or off the input power switch once in a year only. The digital value can be converted through the input and output terminals to analog value, which in turn, is connected to the Electronic Tuner for channel tuning, as necessary. For storing or restoring desired channels is needed complicated electronical operations. To achieve this, the Setting Circuit is provided for ease of switching the input and output terminals.

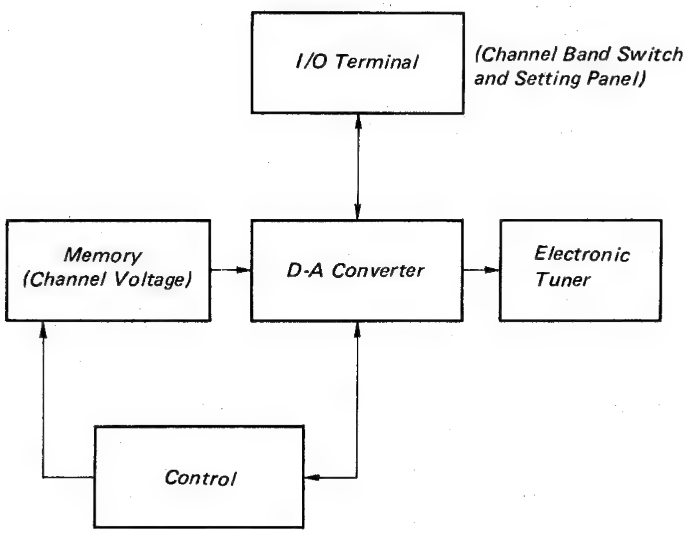


Fig. 3-121 Selector Circuit Block Diagram

3-8. AUDIO SYSTEM

Input Circuit

The INPUT SELECT switch at the rear panel selects a TV or line (CAMERA) signal. If the switch is set to the TV position, the signal from the ET Tuner built in the V-5470 is used. If it is at the LINE (CAMERA) position, the signal from the AUDIO LINE IN terminal at the rear panel is input. As the standard input level is −10 dBs, the input signal is attenuated through the Antenna Terminal board to the microphone level of −70 dBs at 4.7 kΩ and is connected to the Audio Circuit board PW2108. The audio signal at the CAMERA terminal has the microphone level. If a camera microphone is used only, the switch should be set to the LINE (CAMERA) position and the other audio line input should be disconnected because no switch is provided for selecting the camera microphone. If a microphone is plugged into the MIC input terminal at the front panel, this has a priority of excluding the other audio inputs regardless of the switch position.

Audio Head Selector Switch, S701

The switch S701 switches the audio head and the power source for the recording or playback mode. The switch is normally set for playback, where the audio head is connected to the playback amplifier input. In recording or audio dubbing, the switch is actuated by a lever to connect the recording amplifier output to the audio head. It, also, supplies the recording +B power to an erasing oscillator circuit, a recording indicating light, and an audio circuit.

Amplifier 1, IC701

The amplifier 1 (IC701) includes a preamplifier with input from pin 16, output from pin 14, and negative feedback from pin 5, a drive amplifier having 30 dB gain with input from pin 3 and output from pin 5, an output amplifier having 20 dB gain with input from pin 6 and output from pin 10, a recording amplifier having 20 dB gain with input from pin 7 and output from pin 9, and an ALC (automatic level control) circuit.

Amplifier 2, IC702

The amplifier 2 (IC702) serves as a recording preamplifier with input from pin 2, and output from pin 6.

Playback Pre-Amplifier

As the signal picked up by the audio head is too low, the playback direct-coupled pre-amplifier of high-Gm FET (Q708) amplifies it, thereby maintaining a high signal-to-noise ratio.

Playback Compensating Circuit, C701, R702, C705, R751

R702 and C701 connected in series are placed across the audio head in playback to resonate for response compensation at treble frequencies around 10 kHz. C705 and R751, which are negative feedback elements for the preamplifier in the amplifier 1 provides a downward characteristic at bass and medium frequencies and a flat characteristic at treble frequencies by changing the impedance with frequency.

ALC, IC701, D701

In recording, D701 rectifies the audio signal output of pin 10 of IC701 to pulsating voltage so that the sound loudness change may be transformed to DC level variation. The DC level variation is applied to pin 1 to change the impedance between pin 2 and ground. This changing impedance and R715, comprising an attenuator, controls the gain of the drive amplifier and output amplifier in the amplifier 1, thereby achieving the ALC (automatic level control) operation. With positive-going increase of the DC level, the impedance decreases, resulting in high signal attenuation.

Switching Circuit, Q703 Through Q705, Q709

In only the playback mode with reset of audio muting, Q704 is turned off. This allows the playback audio signal to be input to pin 3 of IC701. All of Q703, Q705, and Q709 are on, or conduct, in playback as the playback +12 voltage is applied to their bases through resistors. In playback, Q703 and Q709 inhibits the recording signal to enter pin 3 of IC701. Q705 quickly discharges C721 to prevent action of the ALC circuit in playback.

Recording Compensating Circuit, C713, R711

From pin 9 of IC701 is output the audio signal at a flat frequency response. The audio signal flows through the current regulating resistor R711 to the audio head to record. The audio signal is emphasized at treble frequencies in the time constant determined in terms of R711 and C713 that is connected in parallel therewith. The signal response is further raised at treble frequencies around a point at which the audio head and C713 resonate.

Erase Oscillator Circuit, Q706, Q707, T701

This circuit produces a 50 to 60 kHz erasing signal for use as the bias in recording or audio dubbing, as the erasing current in recording or audio dubbing, or as the erasing current in the full-width erase head recording. The oscillation frequency in recording is determined mainly by a resonant circuit comprised of the full-width erase head, audio erase head, C730, and C731. The one in audio dubbing is determined mainly by a resonant circuit comprised of the audio erase head and C730. The difference of erase oscillation frequency between audio dubbing mode and recording mode is determined within 1.8 kHz with varying the capacitance of C731 which is added the capacitance of C736, C735 or zero (C731 only). The additional capacitance is selected by changing the position of faster tip.

In audio dubbing, Q707 turns off as the REC +12 voltage is not applied to its base through resistor. The erase oscillation signal, then, is rectified through D702 and is charged in the capacitor formed of the shielding wire between pins 4 and 5 on the terminal P704. This prevents current from flowing to the full-width erase head in the whole cycle of the oscillation signal.

In recording, Q707 turns on as the REC +12 voltage is applied to its base through resistor. The erase oscillation signal, then, is rectified through D702, however sine-wave erase current flows to the full-width erase head as a parallel resonant circuit formed of the full-width erase head and C731 resonates at the erase oscillation frequency.

3-9. POWER SYSTEM

3-9-1. AC Power Supply Circuit

General

The Power Supply Circuit used in the V-5470 provides a high safeness, consisting of a mains switch, voltage selector, and separate power transformer. The latter two are provided for availability of different input line voltages. A block diagram of the Power Supply Circuit is shown in Fig. 3-122.

Mains Switch

The mains switch is of double-pole double-throw type. The input line voltage is connected through this main switch to the input voltage selector. Turning off the mains switch electrically disconnects the input line from the input voltage selector.

Input Voltage Selector Circuit

The input voltage selector circuit consists of a voltage selector and power transformer. The primary of the power transformer has two windings, six taps which allow connection of any of a 110 V, 220 V, and 240 V AC line in the manner that the voltage selector connects the primary windings in parallel or series accordingly. The voltage selector, located at the rear panel, was preset at the factory for use of the 220 V AC line.

The separate power transformer has a section bobbin that insulates the primary from the secondary. The transformer, also, has a built-in thermofuse to protect the VTR body against too high temperature inside the transformer.

The method of input voltage selection is illustrated in Fig. 3-123.

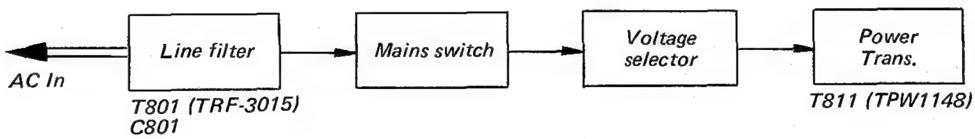
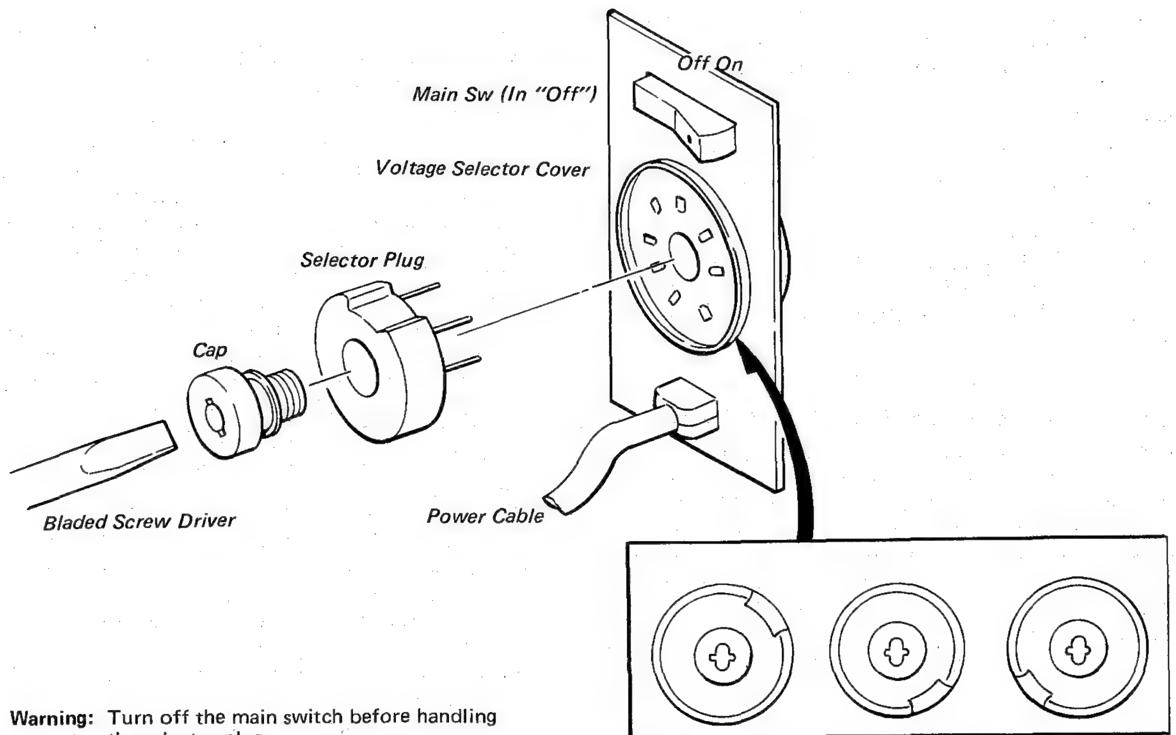


Fig. 3-122 Power Supply Block Diagram



Warning: Turn off the main switch before handling the selector plug.

Note: *It is necessary to change a fuse in 110V area.*

Fig. 3-123 Method of Input Power Voltage Selection

3-9-2. Power Supply

General

The Power Supply Circuit board PW2237 may be broadly comprised of an AC line noise filter, consisting of C801 and T801, and a group of voltage regulators. The AC voltage applied from the secondary of the power transformer T811 is rectified through the bridge circuit of D801 and D802 which are stacked, to obtain DC 17 V, approximately. The DC voltage is fed to the 12 V regulator consisting of R801, Q802, and Q803 and to the 12.4 V regulator, consisting of Q808 and Q809. The DC voltage, also, is used as the +17 V power source for driving the head disk motor and the power source through D811 for the stop solenoid.

The AC voltage from the tertiary of the power transformer T811 is rectified through the bridge circuit, consisting of D804 through D807, to obtain DC 22 V, approximately. The DC voltage is fed to the 16.5 V regulator, consisting of Q804, through Q806 and D808.

12.4 V Voltage Regulator

This regulator is composed of a zener diode D809 and Q808, and is used for the antenna switching circuit on the Antenna Terminal board and for the Programme Timer Circuit board PW2112. This supplies 12.4 V power at all times irrespective of the fact that FUNCTION switch at the front panel is on or stand-by.

16.5 V Voltage Regulator

This regulator composed of Q804, Q805 and Q806 and a zener diode D808, supplies 16.5 V power to the ET Tuner, Selector Circuit board PW2106, Converter Circuit board PW2087, and Servo and Logic Circuit board PW2110.

12 V Voltage Regulator

This regulator composed of Q801, Q802 and Q803 and a zener diode D803, supplies 12 V power the +B power to the functional circuits of the used as VTR body.

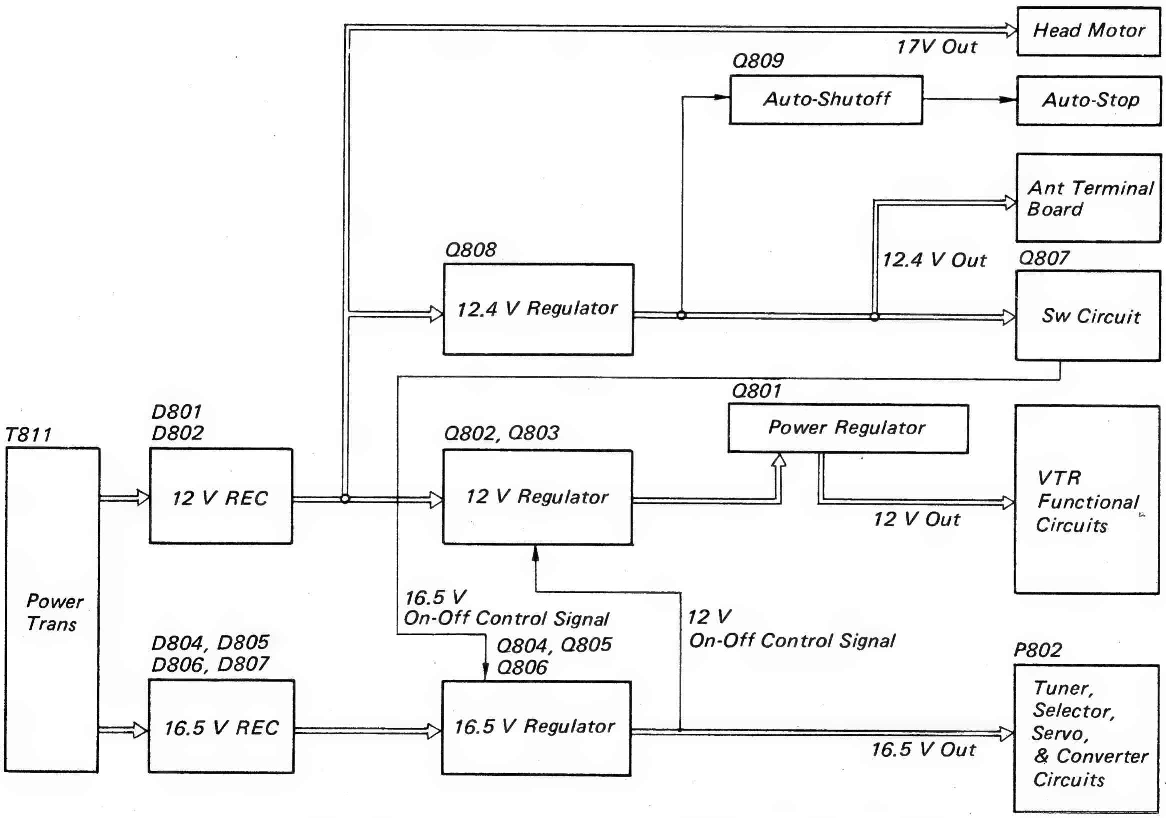


Fig. 3-124 **Power Supply Circuit Block Diagram (PW2237)**

Power On-Off Control Circuit
This circuit operates as follows. When the FUNCTION switch S981 is turned on (FUNCTION), Q807 is turned off as its base is not biased. This allows the 16.5 V and 12 V powers to be fed out. When the switch is off, Q807 is turned on as the base is biased through R805. This grounds the base of Q805 to turn off Q805, then, keeps the +16.5 V power off. The 12 V power, also, is shut off as the base of Q802 in the above-mentioned 12 V regulator is connected through R801 to the 16.5 V power line.
If the FUNCTION switch is turned to the TIMER position, Q807 is turned on to inhibit the power voltages to output as its base is biased for a predetermined period of time through D985 on the Switch Circuit board PW2116 by the Program Timer Circuit board PW2112. When the bias is removed in the predetermined period, Q807 is turned off, allowing the power voltages to be fed out.

Auto-Shutoff Circuit
If the AC line voltage is interrupted by an accident, this inhibits Q808 to output the 12.6 V power voltage. This turns Q809 from the normally "on" state to "off. C641, then, discharges to raise the collector of Q809 to a high level, which energizes the auto-stop solenoid for the stop state.

SECTION 4 ELECTRICAL ADJUSTMENT

GENERAL

The information contained in this section does not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with electrical adjustment. Should further information be desired or should particular problems arise which are not covered sufficiently for the servicing purposes, the matter should be referred to the Toshiba Corporation.

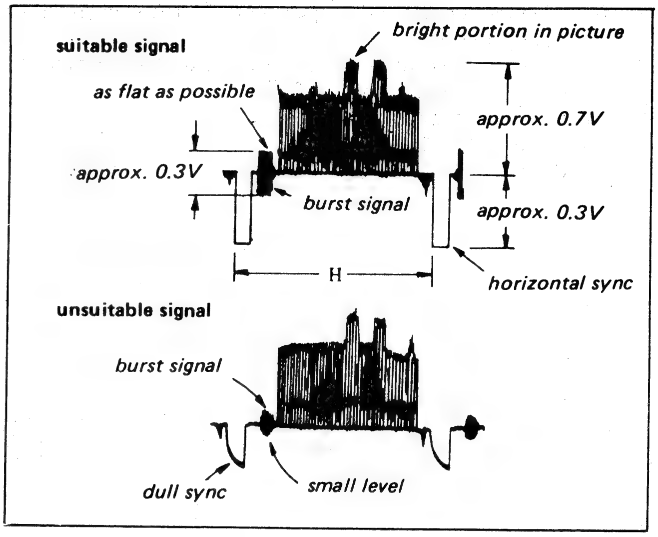


Fig. 4-1 TV video output signal

The suitable output waveform of the color-bar signal generator is shown in Fig. 4-2.

4-1. ALIGNMENT AND ELECTRICAL ADJUSTMENT

All the alignment of this machine can be performed by the procedure using the equipment mentioned below and the TV signal obtained from a TV receiver (an exclusive console or a monitor TV).

4-1-1. Instruments and Tools Required

1. Colour TV receiver
2. Dual-trace oscilloscope having 10 MHz or more bandwidth
3. Colour-bar generator (A rainbow type is impractical.)
4. Frequency counter
5. VTVM
6. VOM (20 kΩ/V)
7. Audio oscillator
8. Audio attenuator
9. KR5-1C alignment tape
10. Alignment jigs and tools, 1 set

4-1-2. Set-up Procedures (see Fig. 4-1)

1. Connect the TV set to the UHF OUT terminal on the rear panel of the V-5470 as illustrated in page 1.
2. Also, connect the UHF antenna to the UHF IN terminal.

NOTE:—A telecast wave can be used as adjustment signal for the V-5470.

3. Set the VTR to the channel at which the TV reception is best.
4. Make certain that the video input signal is around 0.7 Vp-p with an oscilloscope connected to pin-7 of P201 on PW-2109.
5. Also, make certain that the sync signal level is around 0.3 Vp-p.
6. Tune the Varactor Tuner into the channel received so that the burst level is around 0.3 ± 0.1 Vp-p, while observing the picture on the TV screen.
7. Make certain that no spikes can be seen on any sync pulse.

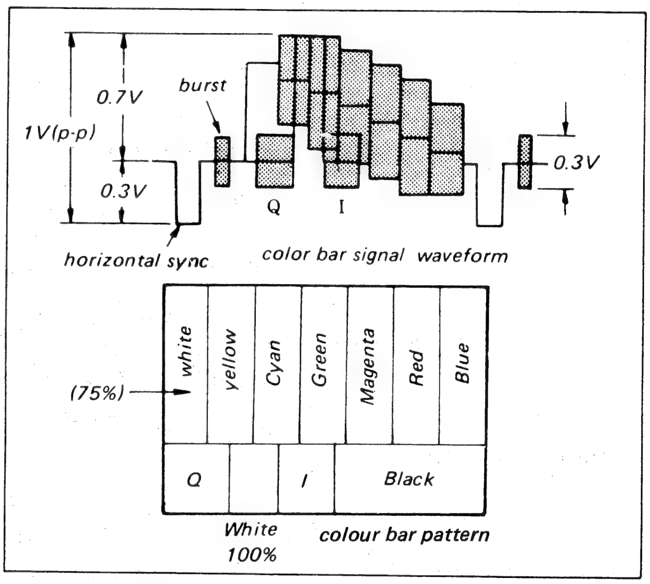


Fig. 4-2 **75% colour bar signal recorded on the alignment tape**

The KR5-1C alignment tape contains the following re-recordings.

	Mode	Video signal	Audio signal	Playing time
1	2H	Colour bar (75%)	3kHz-5dB	5 min.
2	2H	Monoscope	333Hz-25dB	5 min.
3	2H	Sweep	5kHz-25dB	5 min.

4-1-3. Signal Level and Input and Output Impedance Requirement

1. Video input: Negative sync, 1 Vp-p standard composite video signal, 75 Ω.
2. Video output: Same as above.
3. Audio input: –10 dB, 100 kΩ.
4. Audio output: –5 dB, 10 kΩ or less.

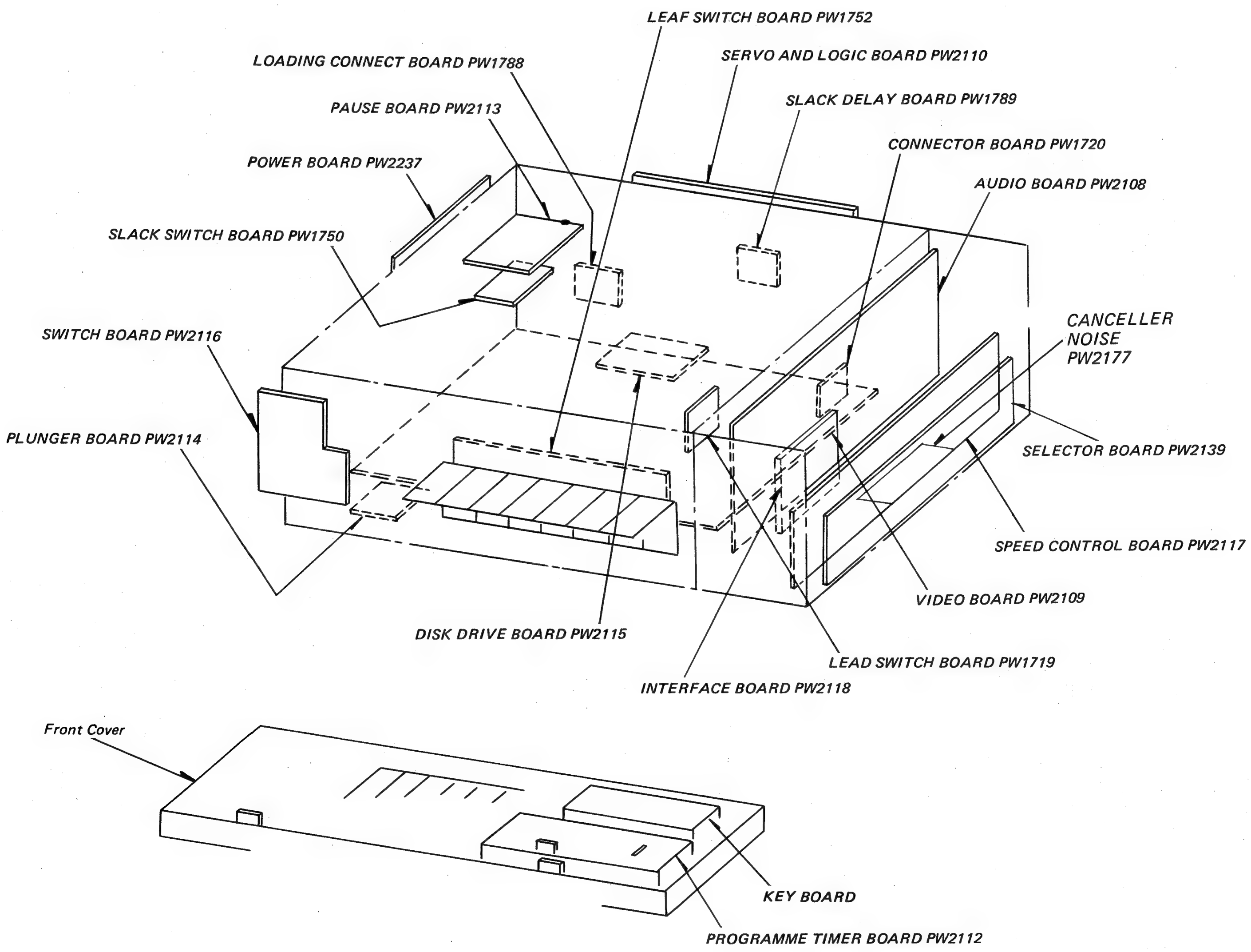
4-1-4. Adjustment Sequence

The V-5470 should be adjusted in the sequence shown below.

Power Supply Alignment
↓
System Control Alignment
↓
DISK DRIVE Alignment
↓
SPEED CONTROL Alignment
↓
Servo Alignment
↓
Color Alignment | Video Alignment | Audio Alignment

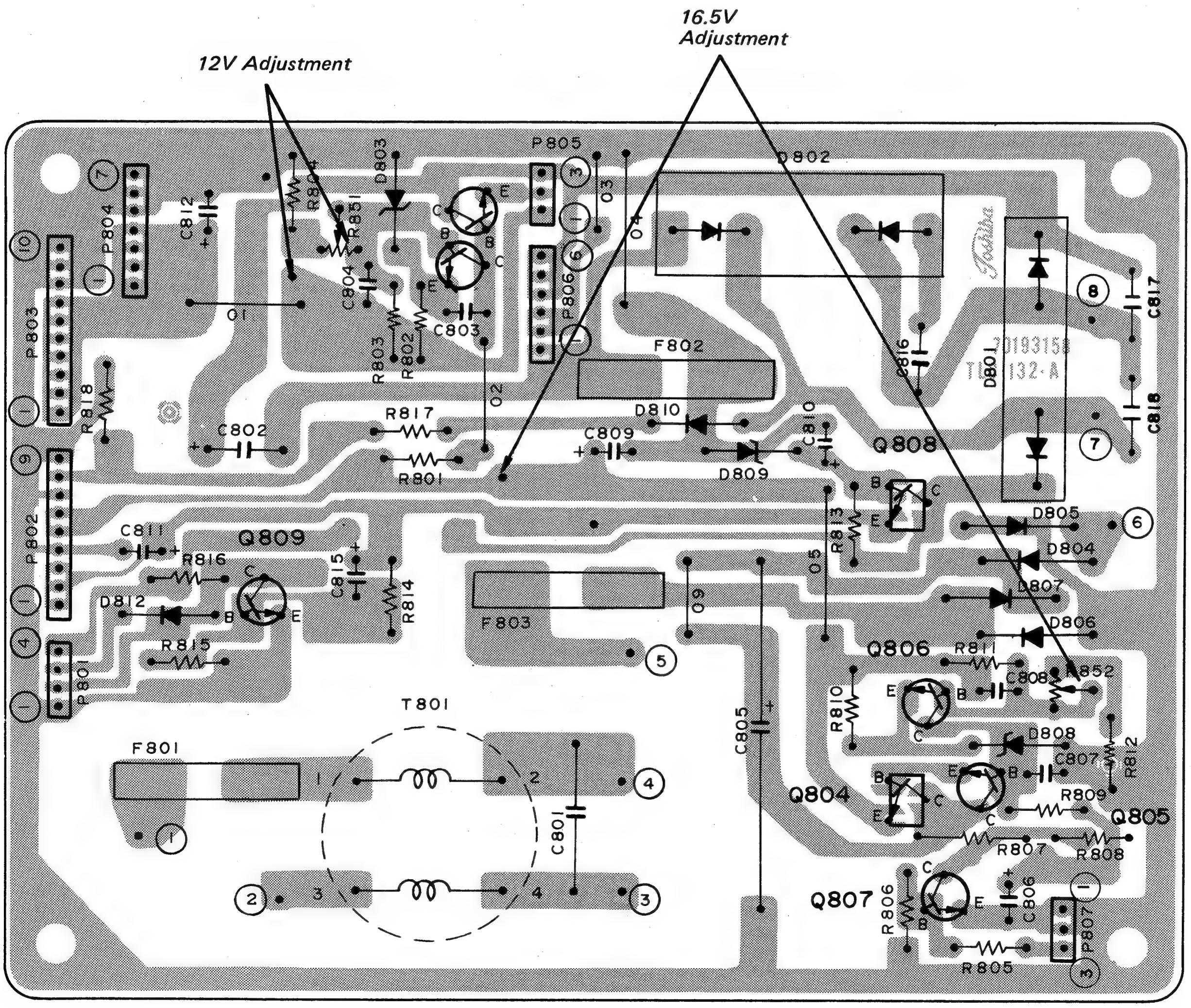
4-2. PW BOARD LOCATION

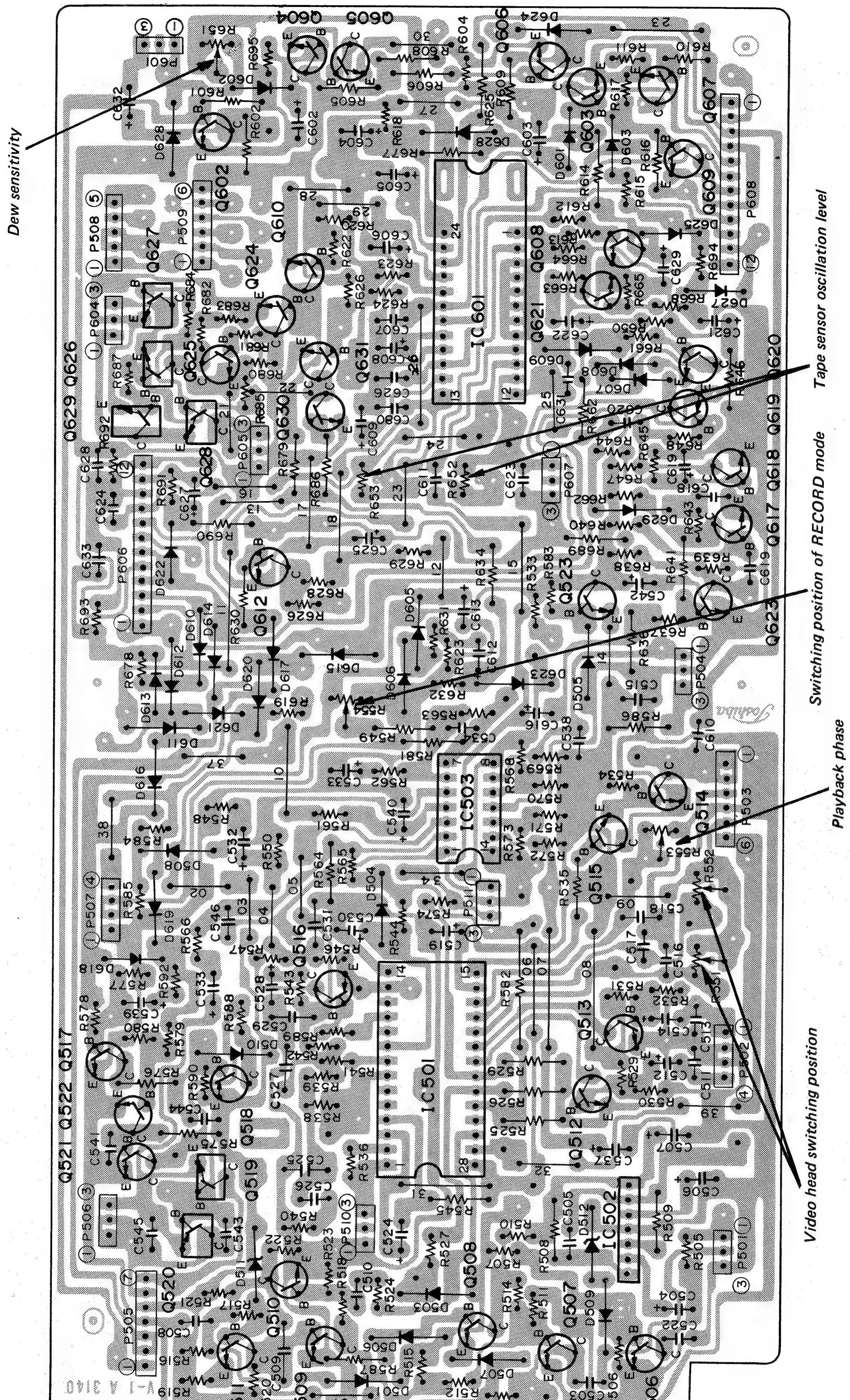
PW BOARD LOCATION



4-3. POWER SUPPLY CIRCUIT ADJUSTMENT METHOD

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	16.5 V adjustment	R852	TP803 (+) TP805 (GND)	VOM (DC range)	16.5V ± 0.3 V
	Measure and adjust with power 'ON', in STOP mode.				
2	12 V adjustment	R851	TP801 (+) TP805 (GND)	VOM (DC range)	12.0V ± 0.05 V
	Measure and adjust with power 'ON', in STOP mode.				




Dew sensitivity
Tape sensor oscillation level
Switching position of RECORD mode
Playback phase
Video head switching position
TLC-132-T-V-1 A 3140

4-4. LOGIC CIRCUIT ADJUSTMENT METHOD

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Dew sensitivity	R651	TP601 Pins 1 and 3 of P601	Visual checking	STAND-BY turns ON by 47 kΩ Resistor and turns OFF by 91 kΩ Resistor.

(1) Insert a cassette into the cassette compartment.
(2) Set the VCR in the recording mode of operation.
(3) Connect a 47 kΩ resistor across Pins 1 and 3 of P601. Check to insure that the stop solenoid is activated to release the REC button and to illuminate the STAND-BY light.

NOTE:— If the stop solenoid is not activated, turn R651 fully counterclockwise and gradually turn it clockwise until the stop solenoid is activated.

(4) Disconnect the 47 kΩ resistor and connect a 91 kΩ resistor in placé. Check to insure that the stop solenoid is released to turn the STAND-BY light off.

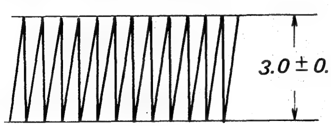
NOTE:— THE 47 KΩ RESISTOR PROMPTS THE STOP SOLENOID TO BE ACTIVATED AND TURN THE STAND-BY LIGHT ON.
THE 91 KΩ RESISTOR PROMPTS THE STOP SOLENOID TO BE ACTIVATED AND TURN THE STAND-BY LIGHT OFF.

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
2	Tape sensor oscillation level	R652 R653	TP603 TP602	Oscilloscope	3.0 ± 0.1 V.

(1) Supply sensor adjustment.
1. Set up the VCR in the playback mode of operation.
2. Connect the oscilloscope to TP603.
3. Adjust R653 until the oscillation level is 3.0 ± 0.1 V.
4. In turn, set the VCR in the fast-forward mode.
5. Check to insure that the level at TP603 is 3.0 ± 0.1 V.

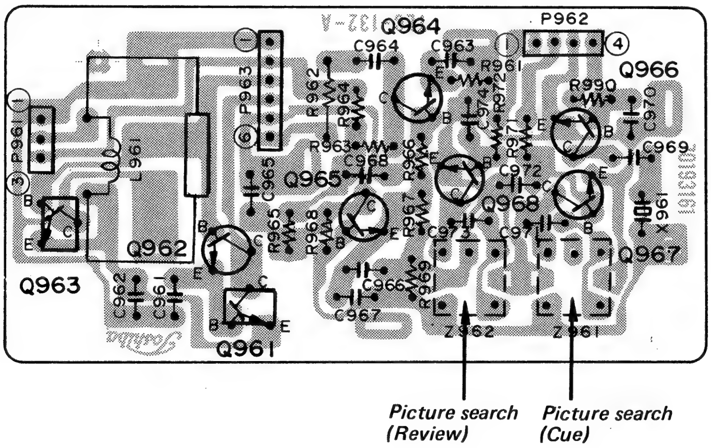
(2) Take-up sensor adjustment.
1. Set up the VCR in the rewind mode of operation.
2. Connect the oscilloscope to TP602.
3. Adjust R652 until the oscillation level is 3.0 ± 0.1 V.

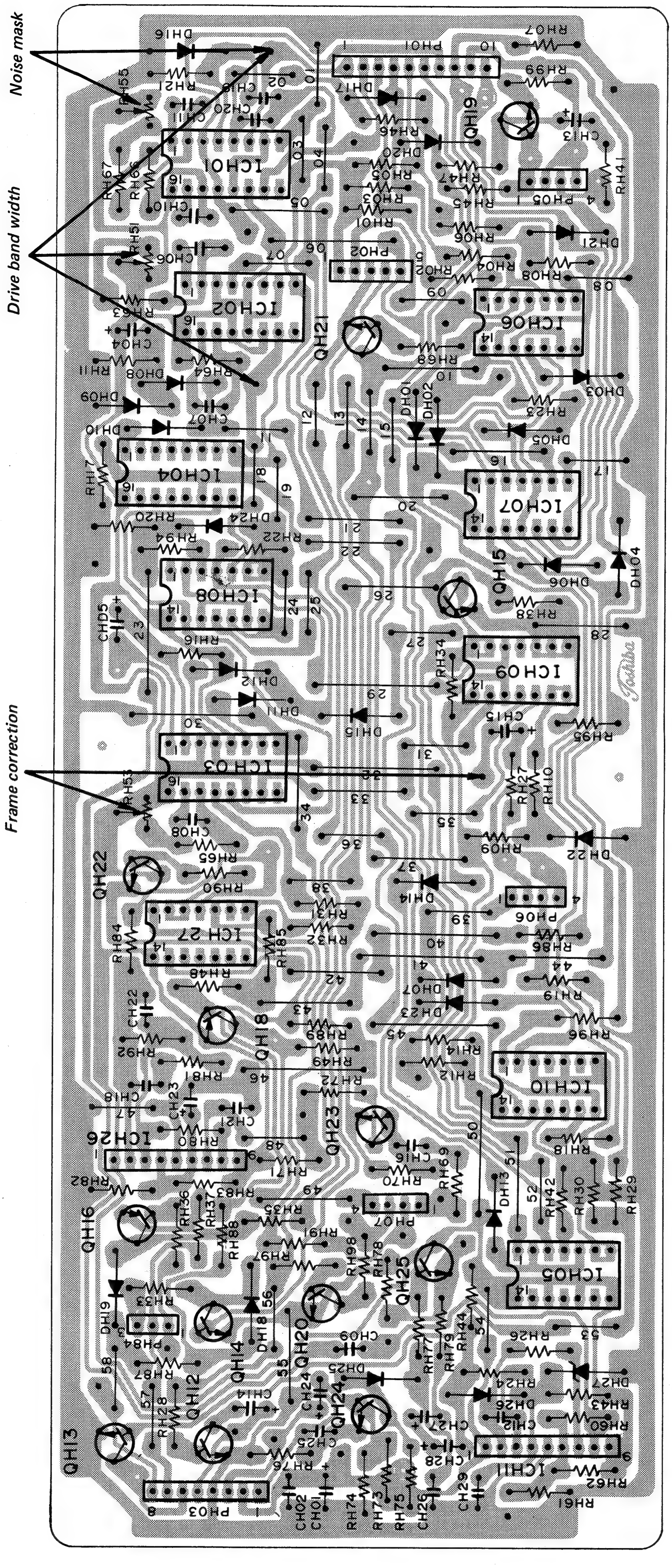
* After Take-up sensor adjustment, confirm and readjust the Supply sensor adjustment.



4-5. DISK DRIVE ADJUSTMENT METHOD

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Clock frequency (Normal)	Confirmation	Pin 3 of P510	Frequency counter	5.9719 ± 0.01 MHz
	(1) Set the VTR to STOP mode. (2) Connect the frequency counter to pin 3 of P510. (3) Confirm 5.9719 MHz ± 0.01 MHz of the frequency counter reading.				
2	Cue adjustment (FF/P-Search)	Z962	Pin 3 of P510	Frequency counter	6.295 MHz ± 20 kHz
	(1) Proceed with step (2) in No. 1 adjustment above. (2) Set the VTR to Forward picture search operation by depressing PLAY and FF/P-search buttons. (3) Adjust Z962 to maintain 6.295 MHz ± 20 kHz of the frequency counter reading.				
3	REVIEW (REW/P-search)	Z961	Pin 3 of P510	Frequency counter	5.610 MHz ± 20 kHz
	(1) Proceed with step (2) in No. 1 adjustment above. (2) Set the VTR to backward picture search operation by depressing PLAY and REW/P-search buttons. (3) Adjust Z961 to maintain 5.610 MHz ± 20 kHz of the frequency counter reading.				

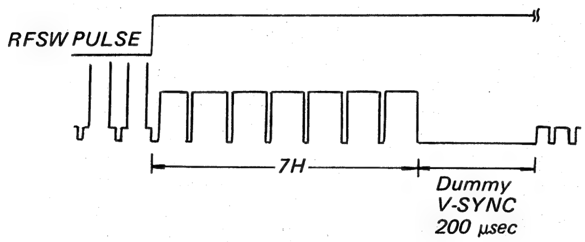


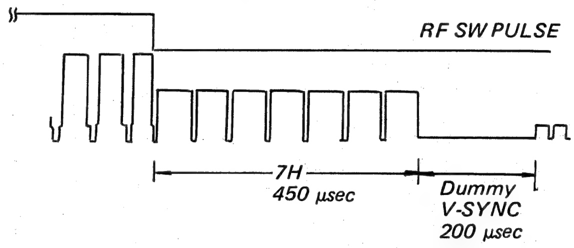

Noise mask
Drive band width
Frame correction

4-6. SPEED CONTROL LOGIC ADJUSTMENT METHOD

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Noise Mask	RH55	VIDEO LINE OUT or TPH06	Oscilloscope	7H before the vertical sync pulse at VIDEO LINE OUT

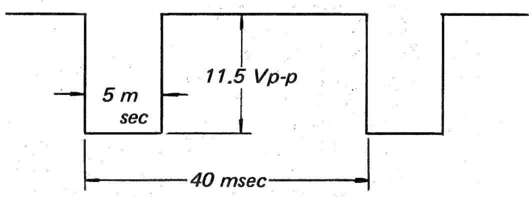
(1) Playback the recorded tape and set the SPEED CONTROL Knob to the STILL position.
(2) Depress the PAUSE/SPEED switch.
(3) Connect the probe of the oscilloscope to the VIDEO LINE OUT terminal of the VTR.
(4) Adjust RH55 to maintain as shown below.
* If the probe is connected to TPH06, adjust RH55 to maintain 450 μsec of the pulse width as shown below.





No.	Item	ADJ location	Checking point	Measuring instrument	Reading
2	Drive Band Width	RH53	TPH05	Oscilloscope	as shown below

(1) Proceed with steps (1) and (2) in the No. 1 adjustment above.
(2) Depress the FRAME switch and hold this switch is depressed.
(3) Connect the probe of the oscilloscope to TPH05 and adjust RH53 to maintain as shown below.

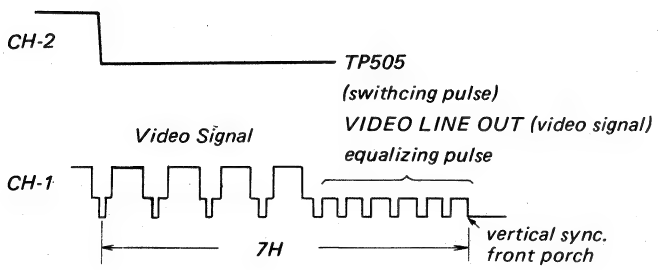


No.	Item	ADJ location	Checking point	Measuring instrument	Reading
3	Frame correction	RH51	visual checking	TV screen	as shown below
	(1) Set the VTR in the still mode while it is recording or playing back. (2) Turn RH51 all the way to the left where bar noise streek on the screen. (3) Gradually turn RH51 clockwise until the bar noise is still on the bottom of the picture or within the vertical blanking period. If the bar noise cannot be hidden away it should be made to appear equally on the top and bottom of the picture. (4) Depress the FRAME switch a time and finely adjust RH51 so that the bar noise can be still on the bottom of the picture or appear equally on the top and bottom. (5) Repeat Step (4) above until the bar noise is still on the bottom of the picture or appears equally on the top and bottom. * Adjustment should be made so that the bar noise can be still on the bottom of the picture or appear equally on the top and bottom.				
4	Picture Search	Confirmation	Visual checking	TV Screen	Confirmation
	(1) Playback the recorded tape which should be L-500 type cassette. (2) Confirm the picture is normal at the start and the end portion of the tape in the picture search operation. (3) If the picture is abnormal, readjust and check the clock pulse frequency. Refer to No. 2 and No. 3 adjustment in the Disk Drive Adjustment Method.				

4-7. SERVO CIRCUIT ADJUSTMENT METHOD

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Switching position of RECORD mode	R554	TP505 TP201	Oscilloscope (dual trace)	7 H before the vertical sync. pulse.

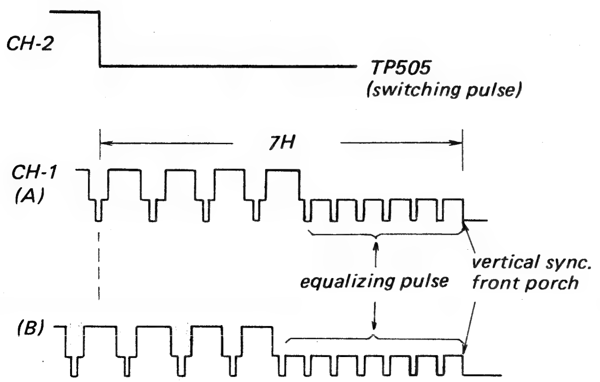
(1) Set up the VCR in the record mode of operation to record a video signal.
(2) Set the dual-trace oscilloscope in the CHOP mode and the sweep time to 100 μsec/cm or less.
(3) Connect the oscilloscope channel 1 to TP201 on the Video Circuit board PW-2109, and the channel 2 to TP505 on the Servo and Logic Circuit board PW-2110. The oscilloscope is to be externally triggered with the switching pulse fed from TP505.
(4) Count the number of H cycles, or of the horizontal sync pulses, as measured from the front porch of the vertical sync signal to the rising edge of the switching pulse.
(5) Adjust R554 until the oscilloscope shows 7 H cycles before the vertical sync pulse.



No.	Item	ADJ location	Checking point	Measuring instrument	Reading
2	Video head switching position	R551 R552	TP505 Video OUT Terminal	Oscilloscope (Dual trace)	7 H before the vertical sync. pulse (both A and B fields)

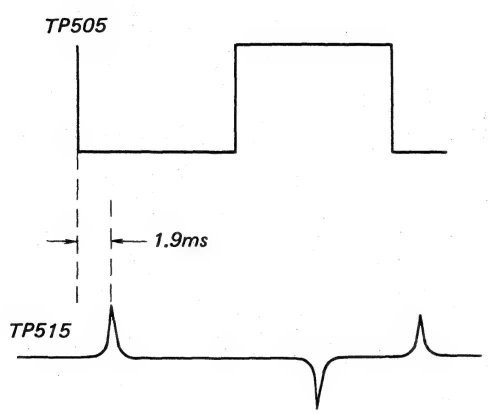
(1) Play back the color bar section of the alignment tape.
(2) Set the dual-trace oscilloscope in the CHOP mode and the sweep time to 100 μsec/cm or less.
(3) Connect the oscilloscope channel 1 to the VIDEO LINE OUT terminal, or to TP203 on the Video Circuit board PW-2109, and the channel 2 to TP505 on the Servo and Logic Circuit board PW-2110.
(4) Count the number of H cycles, or of the horizontal sync pulses, as measured from the front edge of the vertical sync signal to the rising edge of the switching pulse.
(5) Adjust R551 for the positive external trigger until the oscilloscope shows 7 H cycles before the vertical sync pulse.
(6) Also, adjust R552 for the negative external trigger until the oscilloscope shows 7 H cycles before the vertical sync pulse.

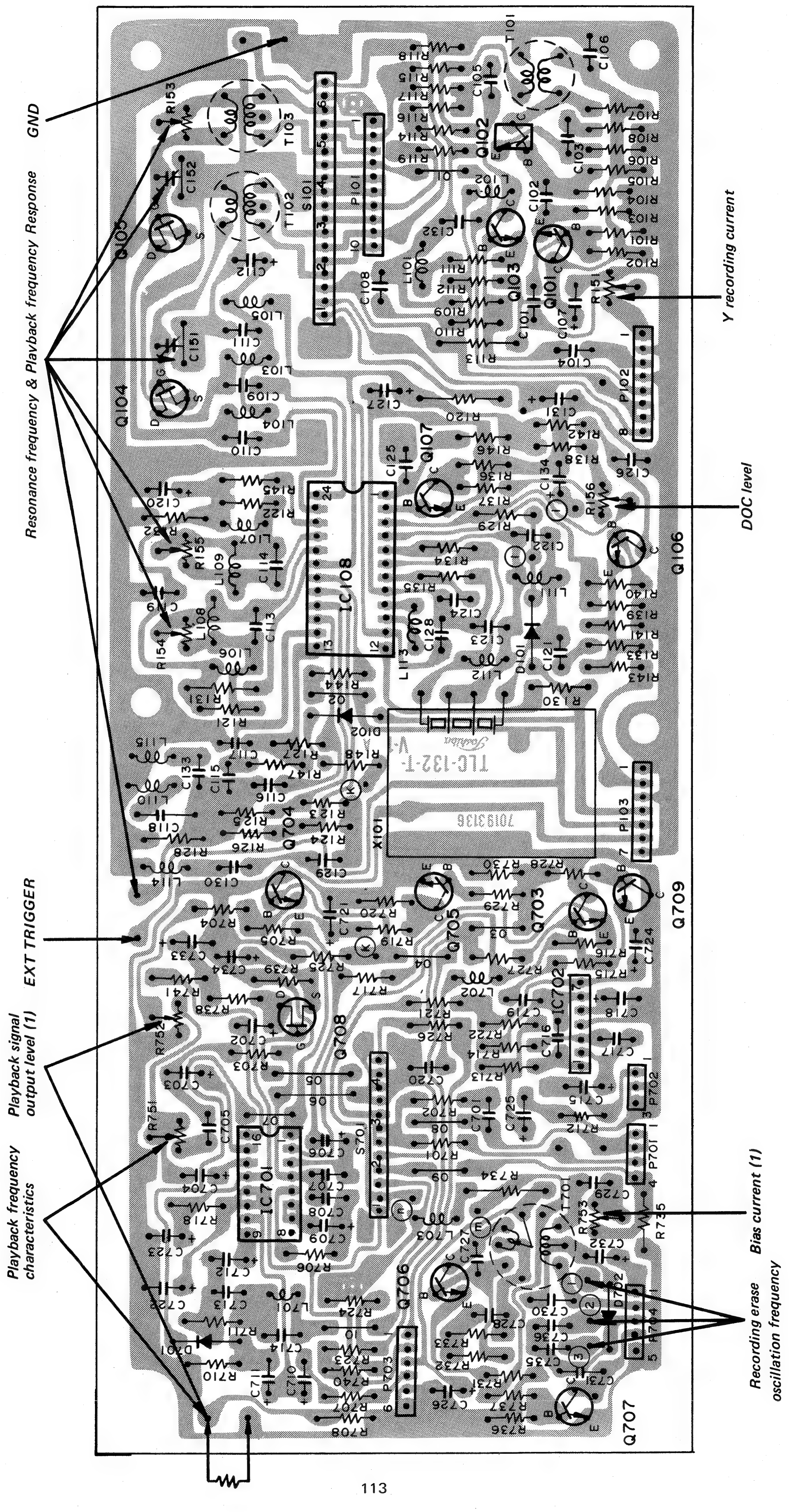
PW2110 SERVO & LOGIC CIRCUIT BOARD



No.	Item	ADJ location	Checking point	Measuring instrument	Reading
3	Playback phase alignment	R553	TP505 TP515	Oscilloscope (Dual trace)	shown below.

(1) Set the TRACKING knob to the mechanical center.
(2) Record and play back the video signal from UHF antenna.
(3) Set the dual-trace oscilloscope in the CHOP mode.
(4) Connect the oscilloscope channel 1 to TP505 and the channel 2 to TP515.
(5) Adjust R553 until the phase difference between the trailing edge of the pulses at TP505 and the positive pulse at TP515 is 1.9 msec as shown below.



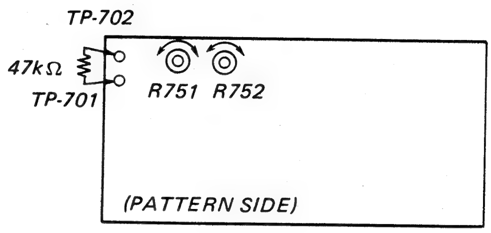

GND
Resonance frequency & Playback frequency Response
EXT TRIGGER
Playback signal output level (1)
Playback frequency characteristics
Y recording current
DOC level
Bias current (1)
Recording erase oscillation frequency
TLC-132-T-
7019136

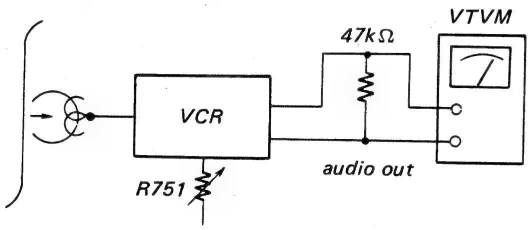
4-8. AUDIO CIRCUIT ADJUSTMENT METHOD

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Playback frequency characteristics	R751	TP701 Audio line output terminal	VTVM-AC Range	Same output level at 333 Hz and 5 kHz by playing back the alignment test tape.

(1) Connect a 47 kΩ resistor across the AUDIO LINE OUT terminal, or TP701 and TP702 (ground).
(2) Also, connect the VTVM across the resistor with it set in the mV range.
(3) Play back the 333 Hz section of the test tape and read the VTVM.
(4) Similarly, play back the 5 kHz section and read the VTVM.
(5) Adjust R751 until the 5 kHz playback output level is the same as the 333 Hz playback output level.

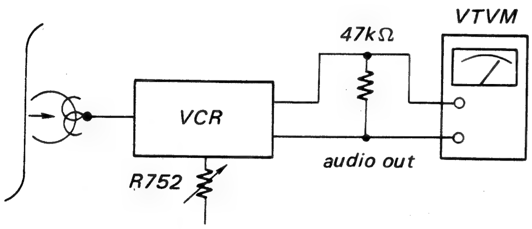
NOTE:— Set the wiper of R752 (PB LEVEL) around the center before adjustment. If it is at the leftmost position, adjustment is not possible.

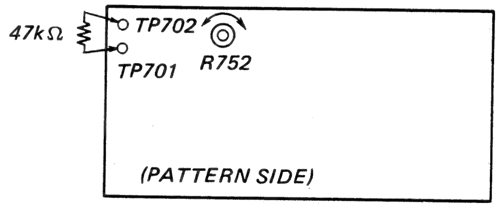




No.	Item	ADJ location	Checking point	Measuring instrument	Reading
2	Playback signal output level (1)	R752	Audio line output terminal	VTVM-AC Range	−3 dBs (0.55 Vrms) at 333 Hz by playing back the alignment test tape.

(1) Connect a 47 kΩ resistor across the AUDIO LINE OUT terminal, or TP701 and TP702 (ground).
(2) Play back the 333 Hz section of the alignment tape and read the VTVM.
(3) Adjust R752 until the 333 Hz output level is −3 dBs (0.55 Vrms) from the reference level.





No.	Item	ADJ location	Checking point	Measuring instrument	Reading
3	Recording erase oscillation frequency	Select fastner tip	Pin 4 of T701	Frequency counter	Less than 1.8 kHz of the difference between the Audio-dubbing oscillation frequency and recording oscillation frequency.

(1) Connect the frequency counter to pin 4 of the transformer T701.
(2) Set the VCR in the Audio-dubbing mode and note the frequency counter read.
(3) Place the fastner tip at position 3 .
(4) Set the VCR in the recording mode and note the frequency counter read.
(5) If this is 1.8 kHz higher than that of the Audio-dubbing mode in Step (2) above, change the fastner tip to position 2 . If lower, then, change it to position 1 .
(6) Check to insure that as a result of position change, the frequency difference is less than 1.8 kHz.

NOTE:— Change of a signal step of the fastner tip will shift the frequency 3 kHz, approximately.

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
4	Bias current (1)	R753	TP703 (TP704-GND)	VTVM-AC Range	The bias current is adjusted to the value shown in table 1.

Table 1:

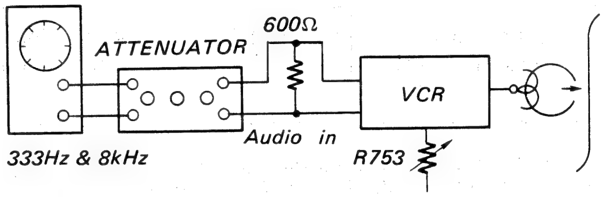
Max. bias current (mVrms)	Below 1.2	1.2 ~ 2.5	Above 2.5
Value of bias current (mVrms)	1/2 of above	0.6	0.9

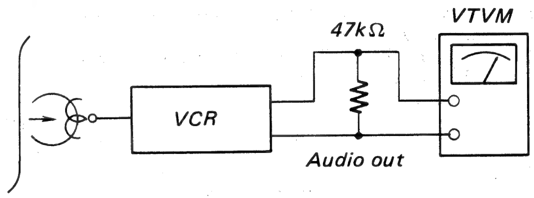
(1) Set the INPUT SELECT switch of the VCR to the LINE position and unplugging the MIC plug.
(2) Select the record mode without the audio signal.
(3) Connect the VTVM (in mV range) across TP703 and TP704 (grounded).
(4) Turn R753 (AUDIO BIAS) fully clockwise as viewed from pattern side of the P.C Board, and read the maximum bias current on the VTVM.
(5) Adjust R753 for the bias current specified in Table 1 above.

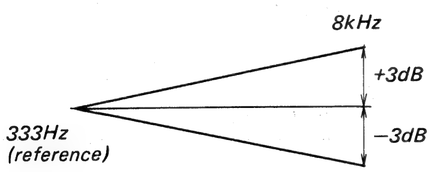
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
5	Bias current (2)	Confirmation (R753)	Audio line output terminal	VTVM-AC Range oscillator attenuator	± 3 dB

(1) Set the INPUT SELECT switch to the LINE position.
(2) Connect the audio oscillator and attenuator to the AUDIO LINE IN terminal of the VCR.
(3) Connect a 47K ohm resistor across the AUDIO LINE OUT terminal, or TP701 and TP702 (ground).
(4) Supply 333 Hz from audio oscillator and feed an input signal of −25 dBs (45 mVrms), adjusted with the attenuator.
(5) Depress the REC button and make a recording.
(6) Change the audio signal to 8 kHz and feed same as item (4) and make a recording.
(7) Playback the recorded portions, and measure the playback output level of 333 Hz and 8 kHz.
(8) Confirm that the playback output level of the 8 kHz is within ±3 dB in reference to the 333 Hz playback output level.
(9) If not, repeat Steps (2) to (8) and adjust the bias current with R753.

AUDIO OSCILLATOR





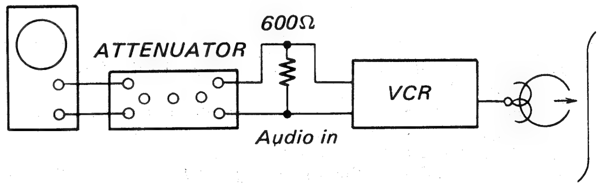


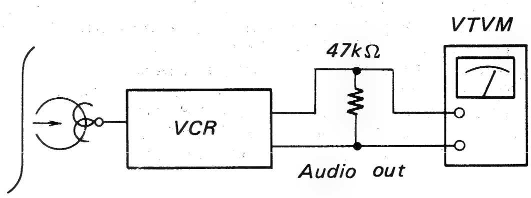
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
6	Playback signal level (2)	Confirmation (R753)	Audio line output terminal	VTVM-AC Range oscillator attenuator	Select record/playback and confirm the playback output signal level is −7 dBs ± 3 dB.

(1) Set the INPUT SELECT switch to the LINE position.
(2) Connect the oscillator, attenuator, 47 kΩ resistor, and VTVM as directed in Steps (2) through (5) in the No. 4 adjustment above.
(3) Feed the reference input signal of −10 dBs (0.25 Vrms) and 333 Hz to the AUDIO LINE IN terminal to record and playback.
(4) Check to insure that the playback output level is within −7 dBs ± 3 dB as read on the VTVM.

NOTE:— If the normal audio frequency response and playback level (2) cannot be obtained as specified above, align the audio head and control head assembly in relation to the tape as described in Section 5 MECHANICAL DESCRIPTION (5-2-48 ADJUSTING THE TAPE PATH), and proceed with No. 1 through 5 adjustments again.

AUDIO OSCILLATOR

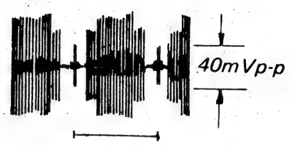




4-9. VIDEO AND COLOUR RECORDING AMPLIFIER CIRCUIT ADJUSTMENT METHOD

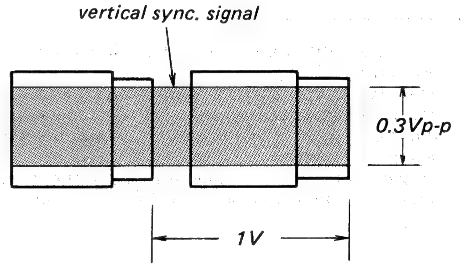
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Colour recording current	R151 R254	TP102 TP103-GND	Oscilloscope	Turn R151 fully counterclockwise and adjust the burst signal level is 40 mVp-p ± 4 mVp-p with R254 on the Video circuit Board PW2109.

(1) Supply the colour video signal to the VIDEO LINE IN of the VCR and select the record mode.
(2) Connect the probe of the scope to TP102 (GND to TP103) and turn R151 fully counterclockwise (as viewed from the pattern side), and then adjust R254 to maintain that the burst signal level without the Y-FM signal is 40 mVp-p ± 4 mVp-p.



No.	Item	ADJ location	Checking point	Measuring instrument	Reading
2	Y recording current	R151	TP102 TP103-GND	Oscilloscope	0.3 Vp-p

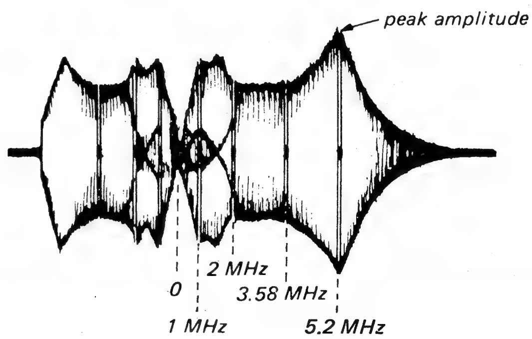
(1) Supply the color video signal to the UHF IN of the VTR and select the record mode.
(2) Connect the probe of the scope to TP102 (TP103-GND) and adjust R151 to maintain the voltage 0.3 Vp-p.

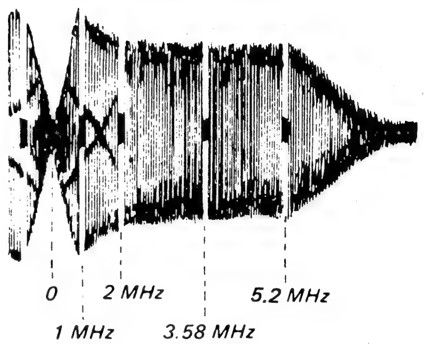


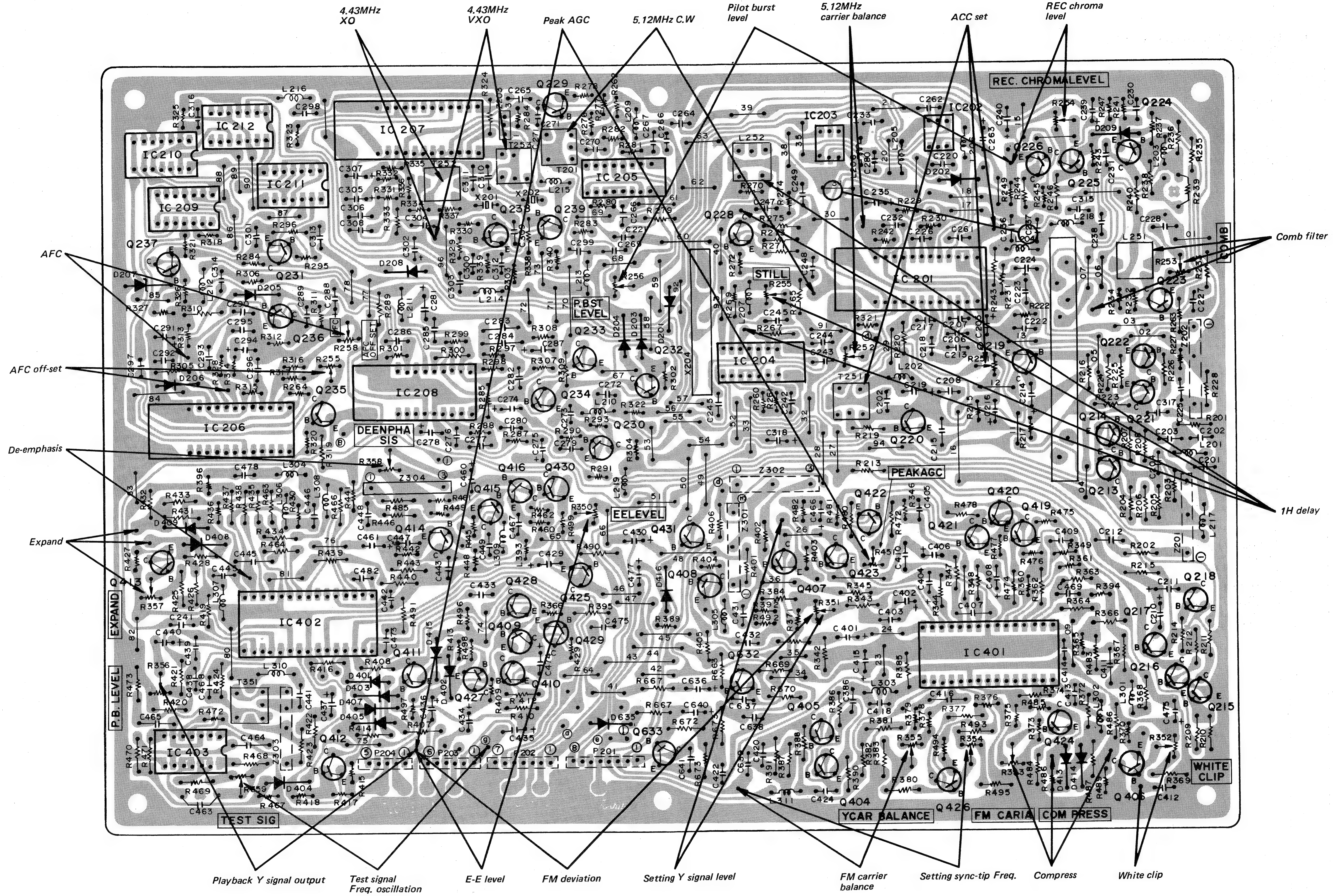
4-10. PLAYBACK PREAMPLIFIER CIRCUIT ADJUSTMENT METHOD

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Resonance freq. A-head B-head	C151 C152	TP105 TP103-GND TP104-TRIG	Oscilloscope	5.2 MHz +0.2 −0.1 MHz resonant frequency on both channels using the alignment test tape.

(1) Playback the RF sweep signal of the alignment test tape.
(2) Turn Q-damp-A (R152) and Q-damp-B (R153) fully clockwise as looked toward the top of the shielding case.
(3) Turn playback frequency response-A (R154) and B (R155) fully counter-clockwise as viewed from the top of the shielding case.
(4) Connect the probe of the scope to TP105 (TP103-GND) and the trigger input of the scope to TP104.
(5) Trigger externally by the (−) slope and adjust the resonant frequency-A (C151), then by (+) slope, adjust the resonant freq. -B (C152) to keep the peak of the waveforms at 5.2 MHz +0.2 −0.1 MHz. Set the horizontal time base of scope to 2 mS/div.



<table>
<tr><th>No.</th><th>Item</th><th>ADJ location</th><th>Checking point</th><th>Measuring instrument</th><th>Reading</th></tr>
<tr><td>2</td><td>Playback
Freq. response
A-head
B-head</td><td>R152
R154
R153
R155</td><td>TP105
TP103-GND
TP104-TRIG</td><td>Oscilloscope</td><td>Flat between 2 MHz and 5.2 MHz (± 1 dB) using the alignment test tape.</td></tr>
<tr><td></td><td colspan="5">(1) Playback the RF sweep signal of the alignment test tape.
(2) Continue to use the same connection of the scope as item 1.
(3) Adjust Q-damp-A (R152) and playback freq. characteristics A (R154) with (—) slope of the external trigger.
(4) Also adjust Q-damp-B (R153) and P-B freq. characteristics B (R155) with (+) slope of the external trigger.
(5) Adjust these potentiometers so that the waveform between the 2 MHz and the 5.2 MHz markers is as flat (± 1 dB) as possible for the both channels.

</td></tr>
<tr><td>3</td><td>D.O.C. level</td><td>R156</td><td>TV screen</td><td></td><td>Lesser dropouts</td></tr>
<tr><td></td><td colspan="5">(1) Playback any pre-recorded tape known to have many dropouts.
(2) Turn R156 (Dropout compensator threshold level) fully counter-clockwise as viewed from the bottom side of the PC Board. The dropouts appear on the monitor screen.
(3) Slowly turn R156 clockwise until the dropouts disappear, while observing it on the TV screen.</td></tr>
</table>

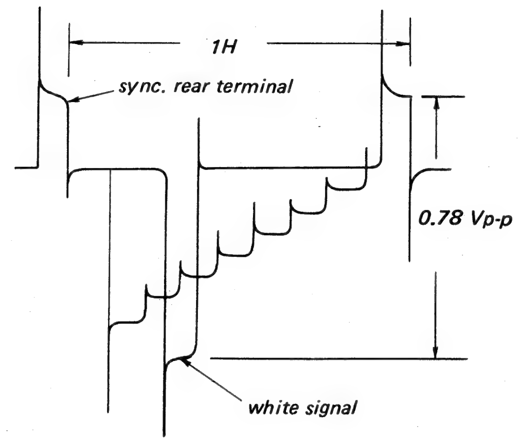

4.43MHz XO
4.43MHz VXO
Peak AGC
5.12MHz C.W
Pilot burst level
5.12MHz carrier balance
ACC set
REC chroma level
Comb filter
AFC
AFC off-set
De-emphasis
Expand
1H delay
Playback Y signal output
Test signal Freq. oscillation
E-E level
FM deviation
Setting Y signal level
FM carrier balance
Setting sync-tip Freq.
Compress
White clip
REC. CHROMALEVEL
COMB
P.BST LEVEL
STILL
DEENPHA SIS
PEAKAGC
EELEVEL
EXPAND
P.B. LEVEL
TEST SIG
YCAR BALANCE
FM CARIA
COM PRESS
WHITE CLIP

4-11. Luminance Circuit Adjustment Method

Playback mode

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	De-emphasis	R358	TP207	Oscilloscope	0.78 Vp-p between sync-tip and white peak

(1) Playback the colour bar section of the Alignment test tape.
(2) Adjust R358 to maintain 0.78 Vp-p between sync-tip and white peak as shown below.

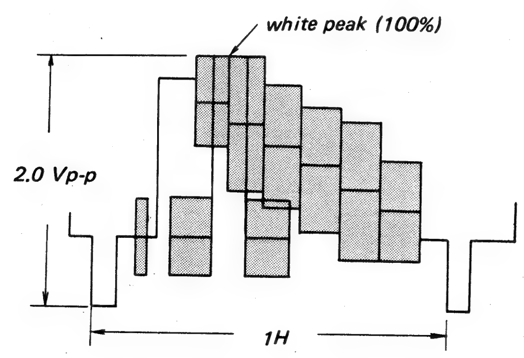


No.	Item	ADJ location	Checking point	Measuring instrument	Reading
2	Expand	R357	TP216 TP217	VTVM	0.2 V_{DC} between TP216 and TP217

(1) Set the VTR into STOP mode.
(2) Connect the + lead of the VTVM to TP216 and – lead to TP216.
(3) Adjust R357 to maintain VTVM reading 0.2 V_{DC}.

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
3	Playback Y signal output	R356	TP203	Oscilloscope	2 Vp-p

(1) Playback the colour bar section of the alignment test tape.
(2) Connect the probe of the oscilloscope to TP203 and adjust R356 to maintain 2.0 Vp-p of the playback Y signal output level at TP203.

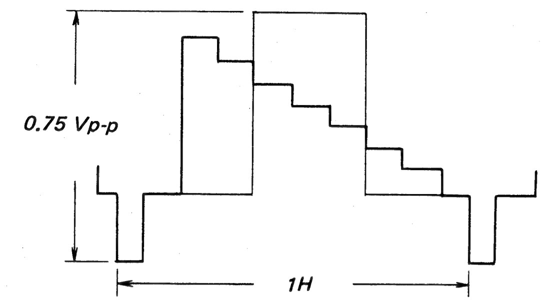


Recording mode

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
1	Setting Y signal level	R351	TP215	Oscilloscope	0.75 Vp-p

(1) Supply the colour bar signal to VIDEO IN terminal of the VTR and set the INPUT select switch to the line side.
(2) Set the VTR to the STOP mode.
(3) Connect the probe of the oscilloscope to TP215 and adjust R351 to maintain 0.75 Vp-p between sync-tip and white peak as shown below.

CAUTION: Confirm the input signal level at TP201 to be 1.0 Vp-p between sync-tip and white peak before this adjustment.

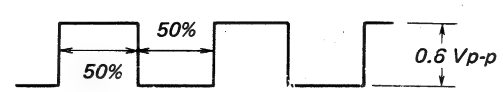


No.	Item	ADJ location	Checking point	Measuring instrument	Reading
2	Sync-tip carrier frequency setting	R354	TP202	Frequency counter	3.85 ± 0.05 MHz

(1) No input state.
(2) Connect the frequency counter to TP202 and adjust R354 to maintain the frequency counter reading 3.85 ± 0.05 MHz.

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
3	FM carrier balance	R355	TP202	Oscilloscope	Duty ratio 50%

(1) No input state.
(2) Connect the probe of the oscilloscope to TP202 and adjust R355 to maintain a 50% duty cycle as shown below.
(3) No need to press any operation buttons.



No.	Item	ADJ location	Checking point	Measuring instrument	Reading
4	White clip	R352	TP214 or base of Q406	VTVM	7.6 V_{DC}

(1) No input state and set the VTR to STOP mode.
(2) Connect the lead of VTVM to the base of Q406 or TP214.
(3) Adjust R352 to maintain 7.6 V_{DC}.

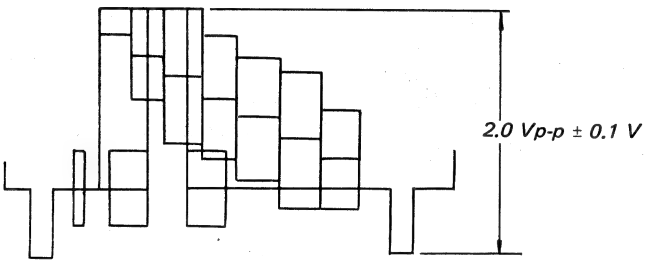
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
5	Compress	R353	TP212 TP213	VTVM	D_C voltage between TP212 and TP213 is 0.2V.

(1) No input state and set the VTR to STOP mode.
(2) Connect the ⊕ lead of VTVM to TP212 and the ⊖ lead to TP213.
(3) Adjust R353 to maintain 0.2 V_{DC} of VTVM reading.

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
6	FM deviation	R351	TP203	Oscilloscope	2.0 Vp-p ± 0.1 V

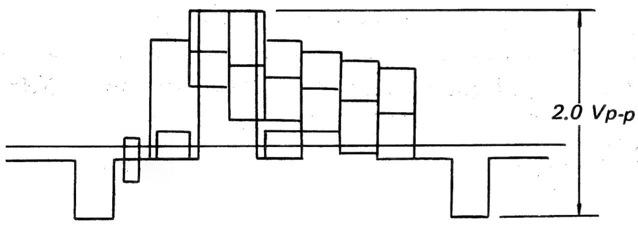
* The playback Y signal output level must be set to 2.0 Vp-p previously. Refer to No. 3 Playback Y signal output adjustment.

(1) Supply the colour bar signal to VIDEO IN terminal of the VTR and set the Input select switch to line side.
(2) Connect the probe of the oscilloscope to TP203.
(3) Record and Playback.
(4) Adjust R351 in the recording mode to maintain 2.0 Vp-p ± 0.1 V of the playback level as same as the No. 3 Playback Y signal output adjustment.



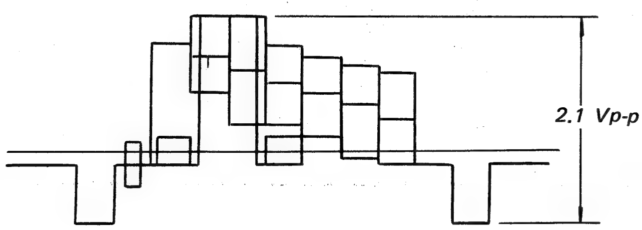
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
7	E-E output level	R350	TP203	Oscilloscope	2.0 Vp-p

(1) Supply the colour bar signal to the VIDEO IN terminal of the VTR and set the VTR to STOP mode.
(2) Connect the probe of the oscilloscope to TP203 and adjust R350 to maintain 2.0 Vp-p of the Video signal level as shown below.

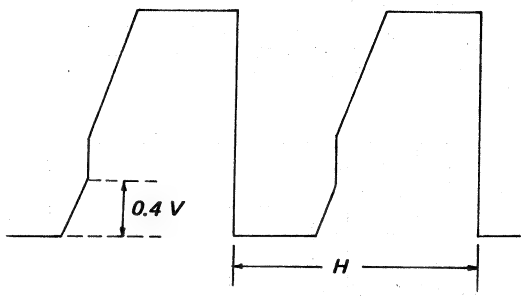
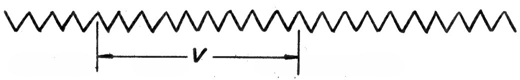
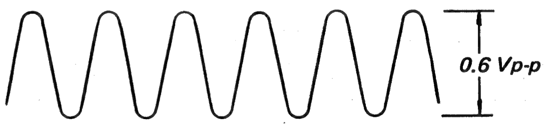
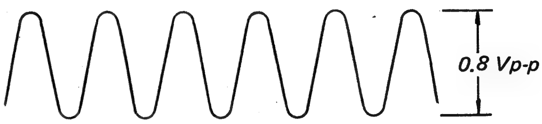


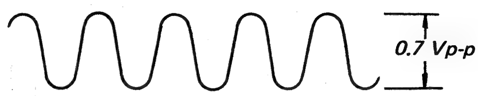
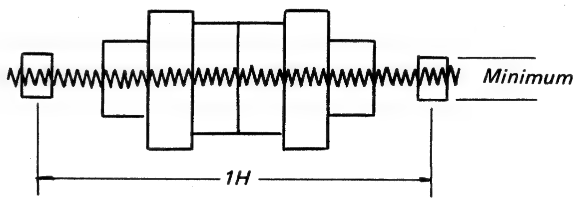
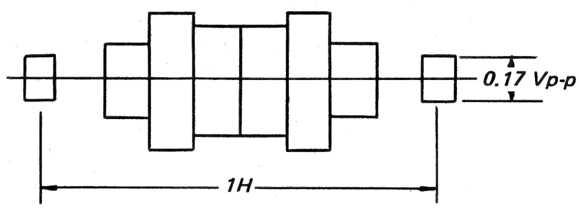
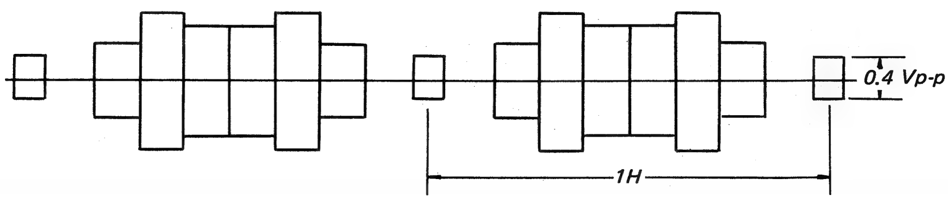
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
8	Peak AGC	R451	TP203	Oscilloscope	2.1 Vp-p

(1) Receive the on-air TV signal, and set the INPUT select switch to TV side and the VTR to STOP mode.
(2) Tune out the tuning of the VTR tuner to change the V/S ratio.
(3) Connect the probe of the oscilloscope to TP203 and adjust R451 until the 100% white peak level measured from the sync-tip is 2.1 Vp-p as shown below.



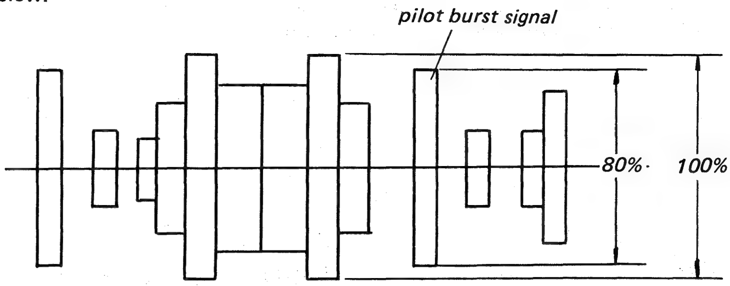
4-12. COLOUR CIRCUIT ADJUSTMENT METHOD

<table>
<tr><th>No.</th><th>Item</th><th>ADJ location</th><th>Checking point</th><th>Measuring instrument</th><th>Reading</th></tr>
<tr><td rowspan="2">1</td><td>AFC</td><td>R257</td><td>TP-223</td><td>Oscilloscope</td><td>As shown below.</td></tr>
<tr><td colspan="3">(1) Supply the colour bar signal to the VIDEO LINE IN terminal and set the input selector switch to the LINE side.
(2) Set the VTR to the stop mode with a cassette inserted.
(3) Connect the probe of the scope to TP-223 and set the time base at 20 μS/div.
(4) Adjust R257 (AFC) to maintain the static waveform as shown in the Fig. below.</td><td colspan="2"></td></tr>
<tr><td rowspan="2">2</td><td>AFC off-set</td><td>R258</td><td>TP224</td><td>Oscilloscope</td><td>as shown below.</td></tr>
<tr><td colspan="3">(1) Supply the colour bar signal to the VIDEO LINE IN terminal and set the Input select switch to the LINE side.
(2) Set the VTR to the RECORD mode with a cassette inserted.
(3) Connect the probe of the oscilloscope to TP224 and adjust R258 to maintain the static waveform to be flat level as shown below.</td><td colspan="2"></td></tr>
<tr><td rowspan="2">5</td><td>4.43 MHz VXO</td><td>T253</td><td>TP211</td><td>Frequency counter</td><td>4.433619 MHz ± 20 Hz</td></tr>
<tr><td colspan="3">(1) No input state and set the VTR to the STOP mode.
(2) Connect the Frequency counter to TP211 and adjust the core of T253 to maintain 4.433619 MHz ± 20 Hz of a frequency counter reading.</td><td colspan="2"></td></tr>
<tr><td rowspan="2">4</td><td>4.43 MHz XO</td><td>T252</td><td>TP211</td><td>Frequency counter</td><td>4.433619 MHz ± 20 Hz</td></tr>
<tr><td colspan="3">(1) Playback the colour bar section of the alignment test tape.
(2) Connect the frequency counter to TP211 and adjust the core of T252 to maintain 4.433619 MHz ± 20 Hz of a frequency counter reading.</td><td colspan="2"></td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>ADJ location</th><th>Checking point</th><th>Measuring instrument</th><th>Reading</th></tr>
<tr><td rowspan="2">5</td><td>5.12 MHz CW</td><td>T201</td><td>TP219</td><td>Oscilloscope</td><td>Maximum level of 5.12 MHz CW</td></tr>
<tr><td colspan="5">(1) Supply the colour bar signal to the VIDEO LINE IN terminal of the VTR and set the VTR to STOP mode.
(2) Connect the probe of the oscilloscope to TP219 and adjust the core of T201 to maintain the maximum level of 5.12 MHz continuous waveform as shown below.
</td></tr>
<tr><td rowspan="2">6</td><td>Comb Filter</td><td>R253
L251</td><td>TP209
TP220</td><td>Oscilloscope</td><td>Minimum level of the chroma signal</td></tr>
<tr><td colspan="5">(1) Supply the colour bar signal to the VIDEO LINE IN terminal of the VTR and set the VTR to STOP mode.
(2) Connect the probe of the oscilloscope to TP209 and adjust R251 to maintain the Burst level to be around 0.2 Vp-p.
(3) Connect the probe of the oscilloscope to TP220 and adjust R253 and L251 to maintain the minimum level of the chroma signal as shown below.
</td></tr>
<tr><td rowspan="2">7</td><td>ACC set</td><td>R251
T251</td><td>TP209</td><td>Oscilloscope</td><td>0.17 Vp-p of the burst signal level</td></tr>
<tr><td colspan="5">(1) Supply the colour bar signal to the VIDEO LINE IN terminal of the VTR and set the VTR to STOP mode.
(2) Connect the probe of the oscilloscope to TP209 and adjust the core of T251 to maintain the burst signal level to be minimum.
(3) Then, adjust R251 to maintain 0.17 Vp-p of the burst signal level.
</td></tr>
<tr><td rowspan="2">8</td><td>Record chroma level</td><td>R254</td><td>TP208</td><td>Oscilloscope</td><td>0.4 Vp-p of the burst signal level</td></tr>
<tr><td colspan="5">(1) Proceed with step (1) in the No. 7 adjustment above.
(2) Connect the probe of the oscilloscope to TP208 and adjust R254 to maintain 0.4 Vp-p of the burst signal level as shown below.
</td></tr>
</table>

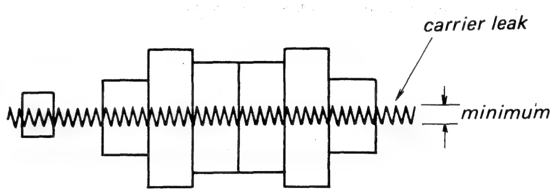
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
9	Pilot burst level	R256	TP208	Oscilloscope	as shown below.

(1) Proceed with step (1) in the No. 7 adjustment above.
(2) Connect the probe of the oscilloscope to TP208 and adjust R256 to maintain as shown below.



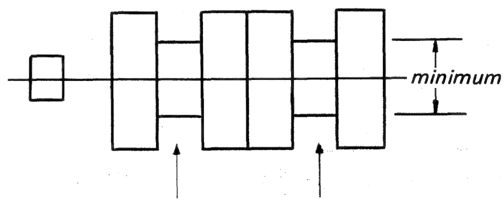
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
10	5.12 MHz carrier balance	R252	TP210	Oscilloscope	Minimum carrier leak of 5.12 MHz

(1) Supply the colour bar signal to the VIDEO LINE IN terminal of the VTR and set the VTR to STOP mode.
(2) Connect the probe of the oscilloscope to TP210 and adjust R252 to maintain the minimum carrier leak of 5.12 MHz as shown below.



No.	Item	ADJ location	Checking point	Measuring instrument	Reading
11	1H Delay	L252 R255	TP222 TP221	Oscilloscope	As shown below.

(1) Playback the colour bar section of the alignment test tape.
(2) Connect the CH-1 probe of the oscilloscope to TP221 and CH-2 probe to TP222.
(3) Set the oscilloscope to ADD (Addition) mode.
(4) Adjust R255 and L252 to maintain the minimum of the added chroma signal level as shown below.



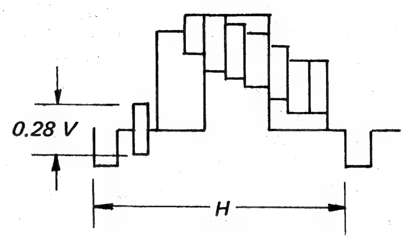
No.	Item	ADJ location	Checking point	Measuring instrument	Reading
12	Test signal oscillation frequency	R359	TP218	Frequency counter	15.625 kHz ± 50 Hz

(1) Turn the Test signal switch ON.
(2) Connect the frequency counter to TP218 and adjust R359 to maintain 15.625 kHz ± 50 Hz of the frequency counter reading.

No.	Item	ADJ location	Checking point	Measuring instrument	Reading
13	Colour mix	R251 (ACC set)	TP203	Oscilloscope	0.28 Vp-p of the burst signal level.

■ **CAUTION:** When the output level of colour burst signal is more or less than 0.28 Vp-p in playback mode, adjust the colour burst level according to the follows.

(1) Playback the colour bar section of the alignment test tape.
(2) Connect the probe of the oscilloscope to TP203 and adjust R251 to maintain that the colour burst level is 0.28 Vp-p.
(3) Readjust the REC chroma level as described in No. 8 Record chroma level.



SECTION 5 MECHANICAL DESCRIPTION

5-1 MECHANICAL HANDLING PROCEDURES

5-1-1 Brief Description of Mechanical Operations

(1) Cassette detection, lock detection, record safety detection, and loading ring lock detection.

Cassette detecting operation.

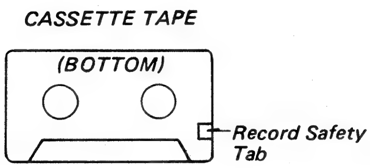
1. When the cassette compartment is depressed after inserting the cassette having the record safety tab, the record safety bracket ① is pressed down to the end, and the locker ② is locked completely because the portion Ⓐ is released. The lead switch ③ passes a loading voltage.
2. With record safety bracket ① pressed down to the end, the REC button and AUDIO DUB button can be depressed because the REC slider ④ and AUDIO DUB slider ⑤ are free to move as shown in Fig. 5-1.

Cassette lock detecting operation.

1. When the cassette compartment is depressed without the cassette, the absence of cassette does not press down the record safety bracket ①. However, the lead switch ③ does not pass a loading voltage because the locker ② can not lock without release of portion Ⓐ.
2. The REC button and AUDIO DUB button can not depress because the REC slider ④ and AUDIO DUB slider ⑤ are not free to move as shown in Fig. 5-2.

Record safety detecting operation.

1. When the record safety tab is broken, the record safety bracket ① is not pressed down completely to the end, but the locker is locked because the portion Ⓐ is released. The lead switch ③ passes a loading voltage.
2. As the record safety bracket ① is not at the end, it stops the REC slider ④ and AUDIO DUB slider ⑤ as shown in Fig. 5-3.
   This means that REC button and AUDIO DUB button can not be depressed.



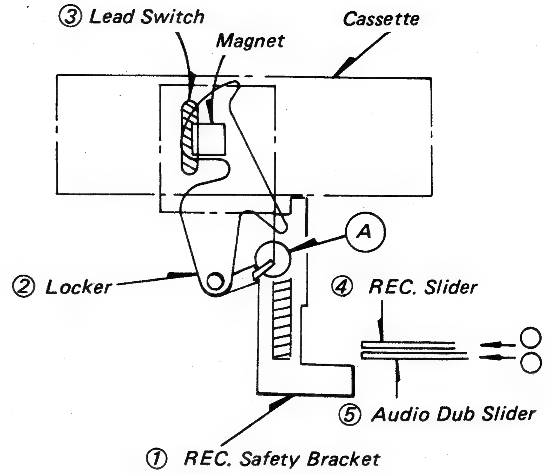


Fig. 5-1 Detecting Arrangement with Cassette Loaded

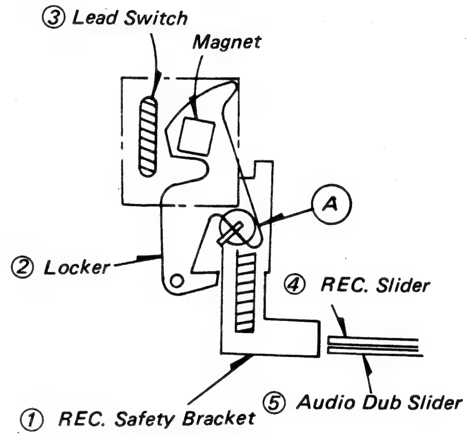


Fig. 5-2 Detecting Arrangement in Non-Cassette State

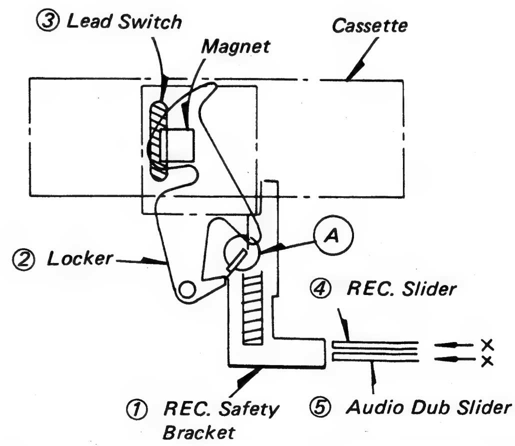


Fig. 5-3 Detecting Arrangement in Record Safety State

Loading ring lock detecting operation.

(A) Without cassette (as shown in Fig. 5-4)

1) Cassette detect lever②is lifted up by the force of lever spring①.
2) The pawl of the cassette detect lever② locks the detect lever③
3) Roller of detect lever③gets into the dent of loading ring thereby locking the loading ring④

NOTE: -When EJECT button is depressed, the loading ring operates as figure shown above.

(B) With Cassette (as shown in Fig. 5-5)

1) Cassette detect lever ② is depressed by the weight of cassette.
2) Detect lever③is released and its roller gets out of dent by the force of detect spring.
3) Loading ring is released.

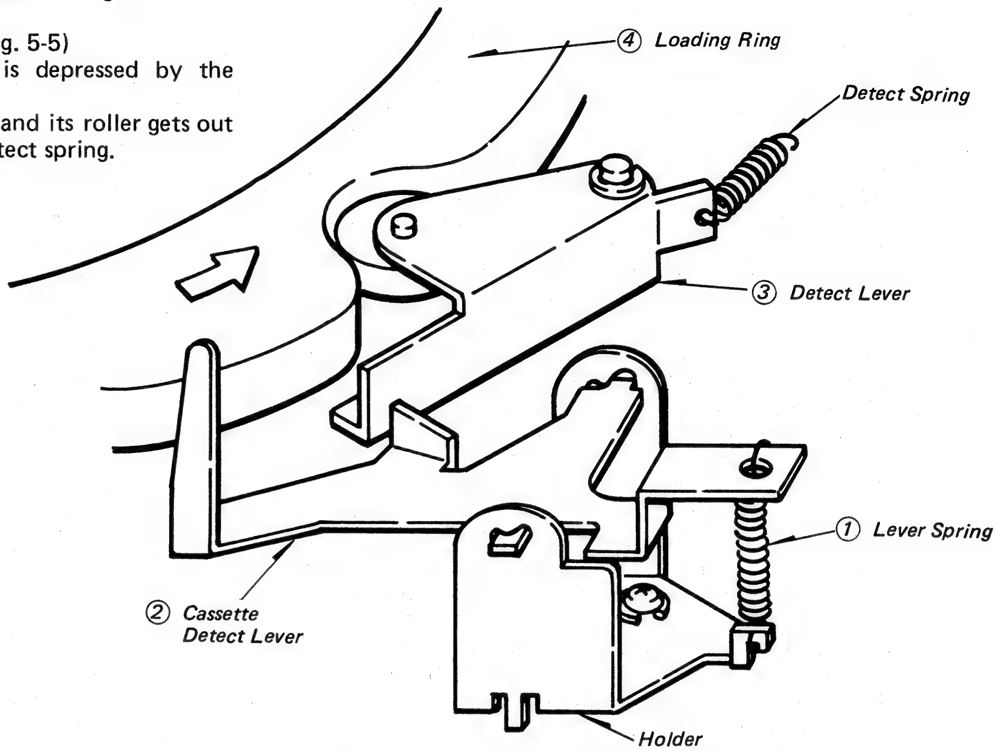


Fig. 5-4 Detecting Arrangement without Cassette

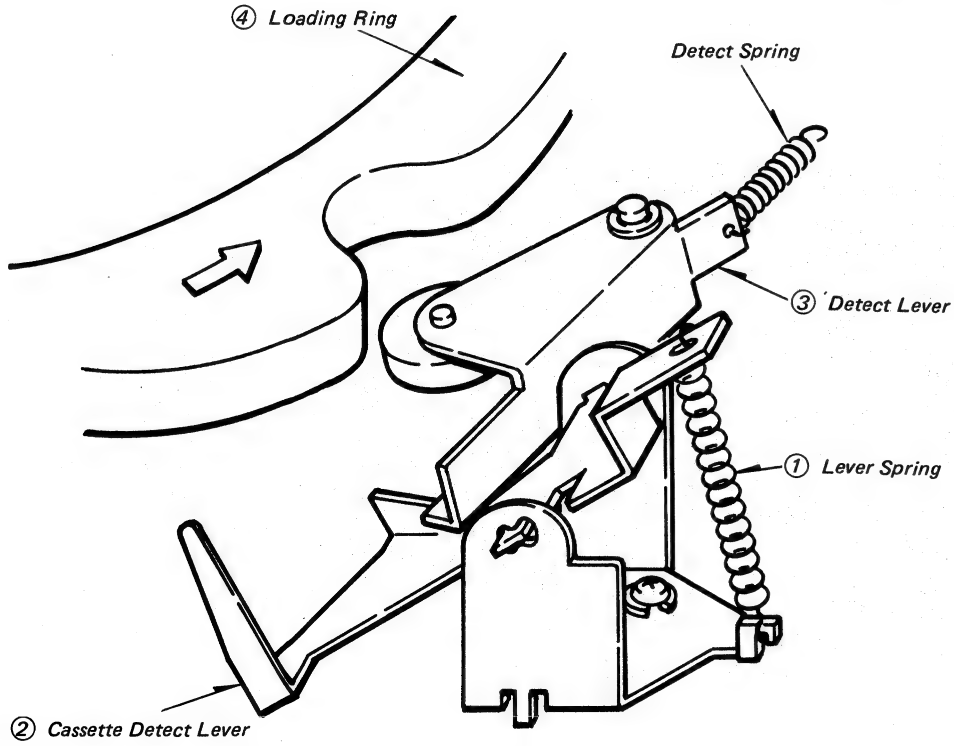


Fig. 5-5 Detecting Arrangement with Cassette

(2) Tape loading operation

When a cassette is inserted into the cassette compartment and pressed down in place to lock, the lead switch passes the loading signal. The signal drives the loading motor and actuates the gears in the loading drive assembly. The gears drive the loading ring held on the loading disk roller. While the loading ring turns, the loading guide post, pinch roller, and first, second, and third tape guide posts that are mounted on the loading ring bring the tape out from the cassette gradually. The tape, then, is arranged in place on the tape transport system in the order of the inlet guide and full width erase heads, cylinder, audio control head, and outlet guide. (see Figs. 5-6, -10.)

On the loading ring is a grooved cam way, along which the cam follower lever is guided to bring the tape out to a specified position. At the end of tape loading, the cam follower lever comes into the concave section on the cam way. The lever, then, presses the loading end detection switch, which produces a loading end signal. The signal stops the rotation of the gears on the loading drive assembly. (see Figs. 5-6, -8, -10.)

It should be noted that the FF/P.SEARCH button and REW/P.SEARCH button cannot be pressed before tape loading, or where the tape is not arranged on the tape transport system yet, although the PLAY button and REC button can be depressed to lock.

(3) Tape Unloading operation

When the EJECT button is depressed, first the cam follower lever comes away from the cam way on the loading ring, or it stands by the unloading state. Second, the Eject leaf switch gives an unloading signal, which inverts rotation of the gears on the loading drive assembly. The gears, then, drive the loading ring, which allows the tape to be rewound into the cassette as the take-up reel table is driven by the play idler.

(4) Auto-stop mechanism operation

1. In the playback or record mode of operation, the slack lever prompts the auto-stop mechanism to stop the operation when it detects slack on the tape.
2. When the fast forward, rewind, playback or recording tape ends, the tape sensing coil produces a signal, which prompts the auto-stop mechanism to stop the operation.
3. In the rewind mode, the auto-stop mechanism stops rewinding when the Tape Counter reads "9999" with the COUNTER MEMORY switch in the ON position.
4. In the playback, recording, fast foward, rewind, or cassette eject operation, the auto-stop mechanism also functions to stop the operation when the video head disk assembly revolution is stopped due to sticking of tape on the cylinder.
5. If dew occurs on the surface of the cylinder, the dew sensor detects it and activates the auto-stop solenoid to hold the tape stopped until the dew disappears. While the solenoid is energized, each operating push button cannot be locked, and it can not function even when pressed until dew is dissipated.

(5) Drive mechanisms (see Figs. 5-6, -7)

1. The loading disk is driven by the DC motor assigned to it only (Loading Drive Assembly).
2. The Video Heads are driven by the DC motor assigned to it only (Disk Motor).
3. The capstan and reels are driven by one DC motor (Capstan Motor).
4. The capstan is driven by the motor pulley through the flat belt.
5. In the reel drive system, the motor pulley turns the guide pulley through the flat belt. The guide pulley turns the fast-foward idler through the square-belt. The fast-foward idler transports the turning power to.
   a. Play idler, which turns the take-up reel table in the recording or playback mode of operation.
   b. Rewind idler, which turns the supply reel table in the rewind mode.
   c. Take-up reel table in the fast-forward mode.

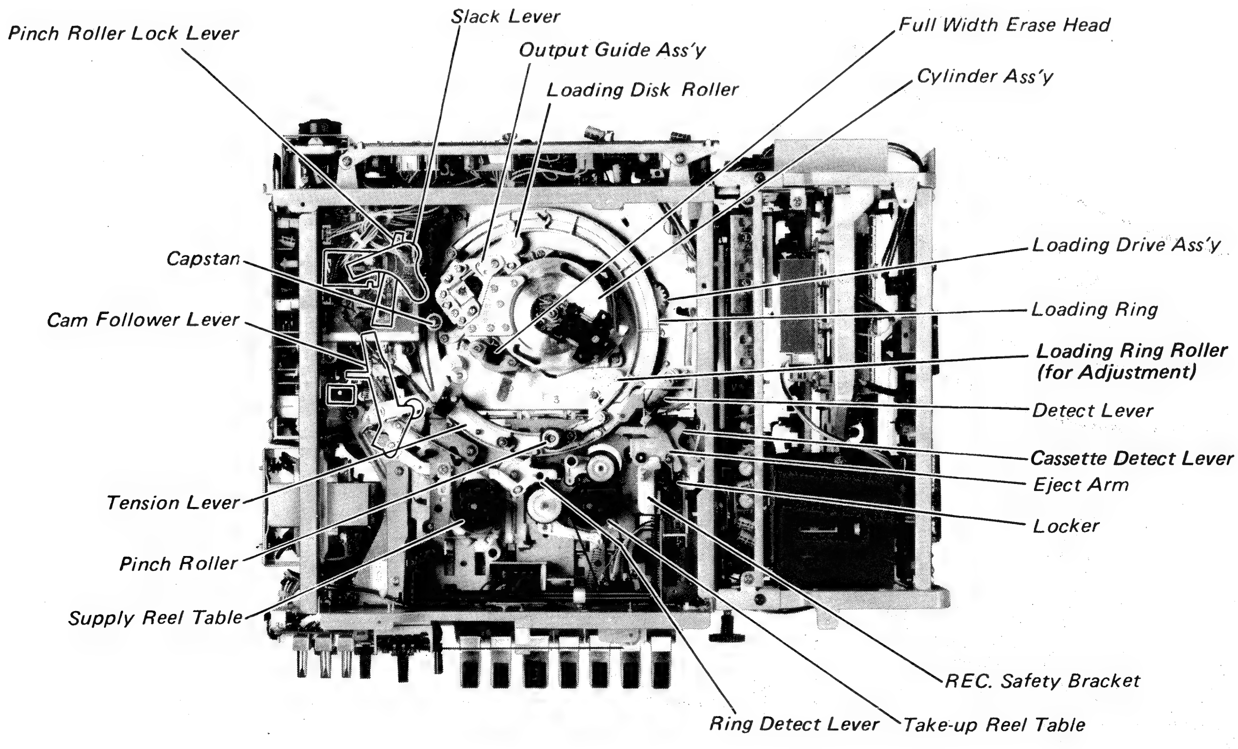


Fig. 5-6 Parts Designation

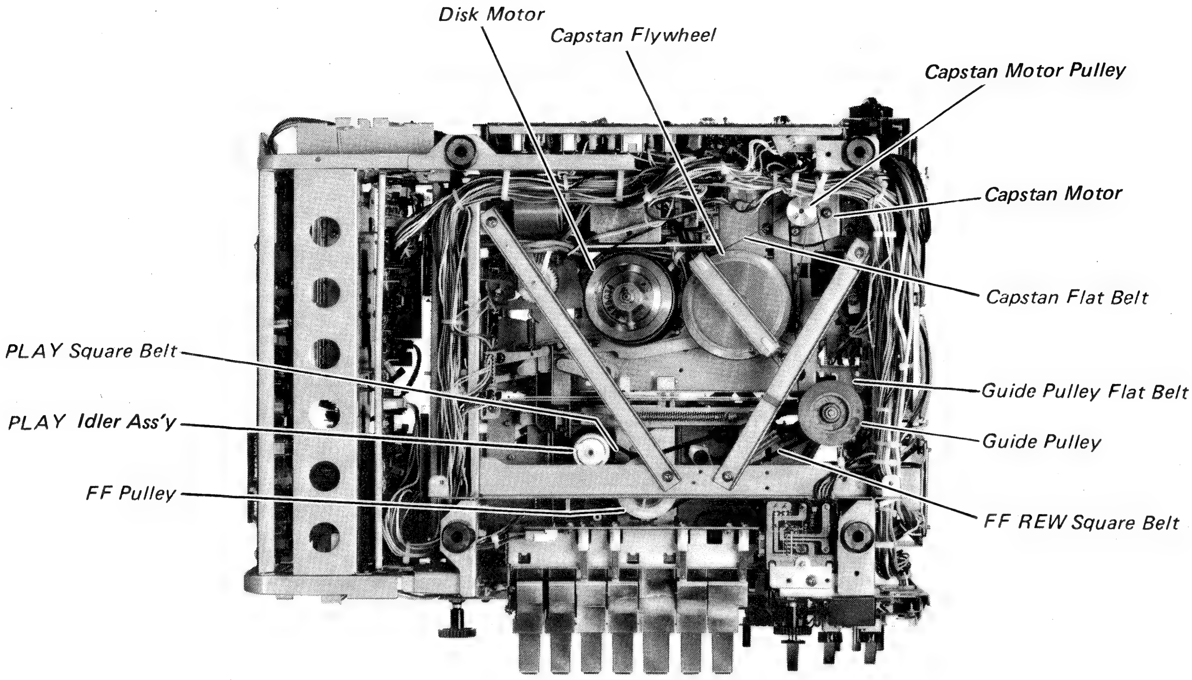


Fig. 5-7 Location of Drive Belts

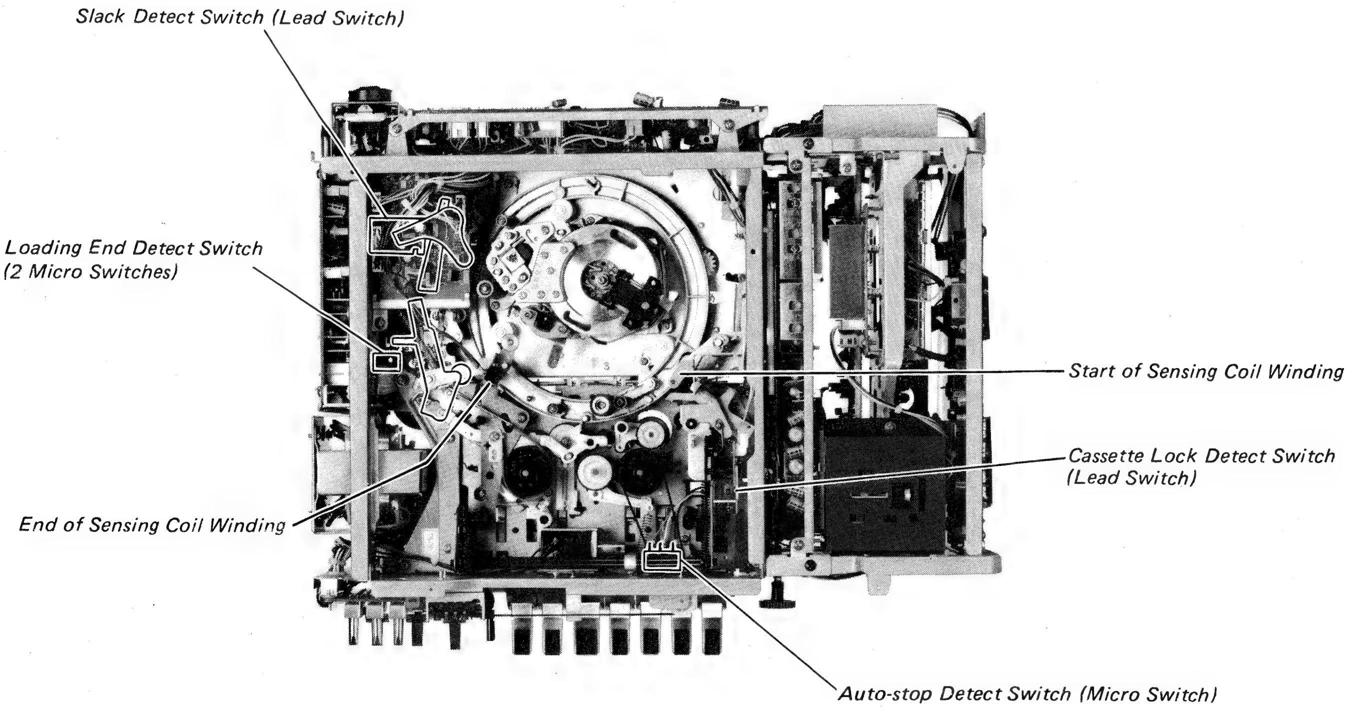


Fig. 5-8 Location of Detecting Switch

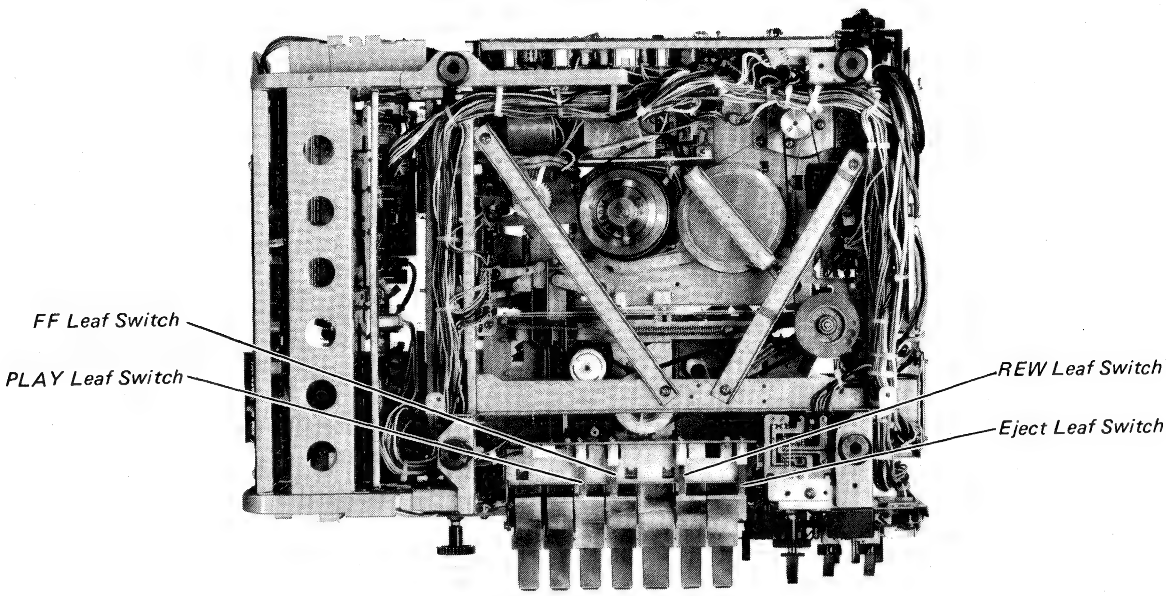


Fig. 5-9 Location of Operating Switch

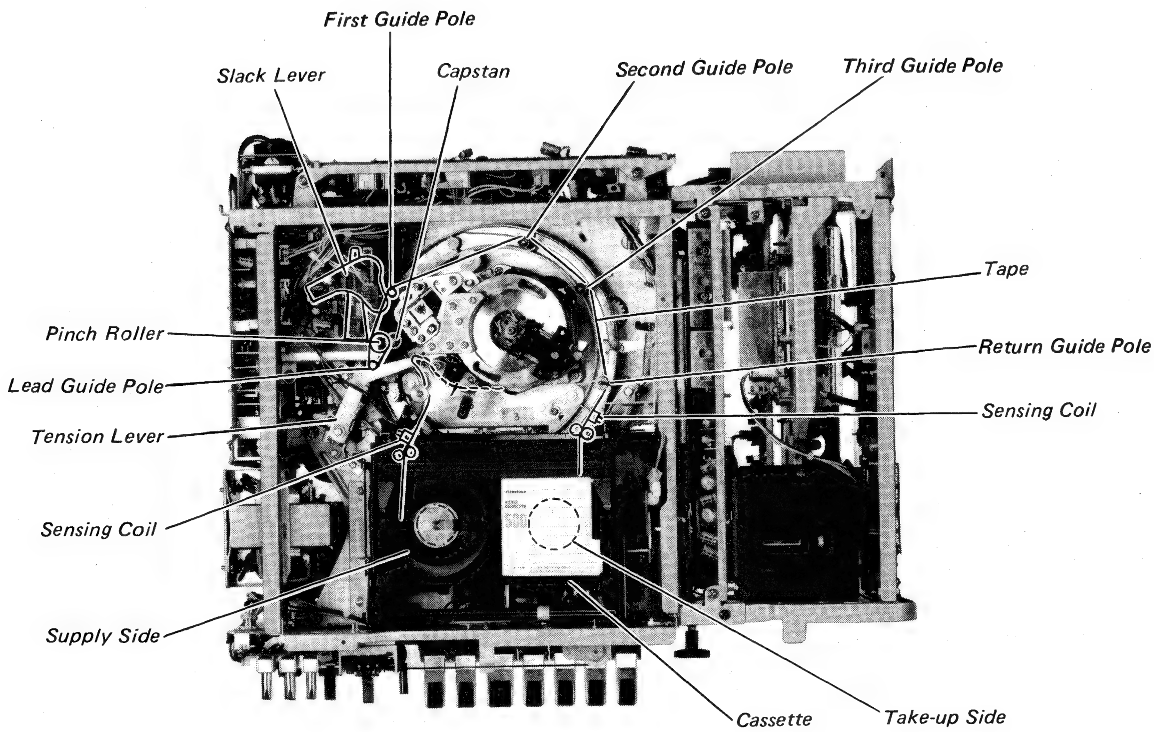


Fig. 5-10 Tape Running

5-1-2 How To Remove the Cabinet (see Fig. 5-11, 5-12)

To remove the cabinet from the VTR body, proceed as follows.

1. **Removing the top cover**
   (1) Depress the EJECT button for opening the cassette compartment.
   (2) Remove the three screws holding the top cover ①.
   (3) Lift the top cover for removal.
2. **Removing the bottom cover**
   (1) Remove the four screws holding the bottom cover ②.
   (2) Take the bottom cover out for removal.
3. **Removing the back cover**
   (1) Remove the four screws holding the back cover ③.
   (2) Take the bottom cover out for removal.
4. **Removing the side plates**
   (1) Remove the one screw holding the side plate (R) ④.
   (2) Take the side plate (R) out for removal.
   (3) Similarly, remove the side plate (L) ⑤.

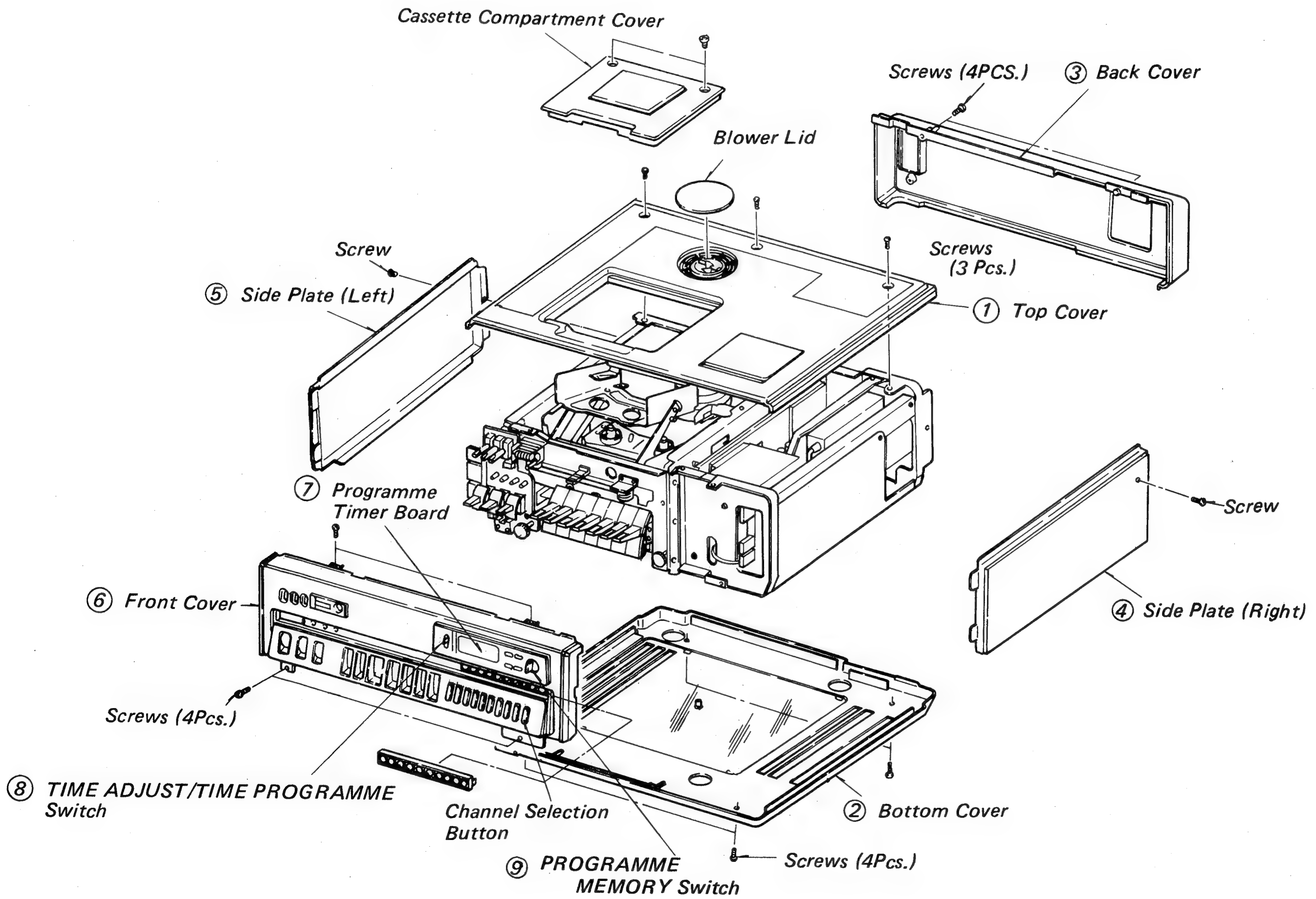


Fig. 5-11 Cabinet Removal and Assembly

5. Removing the front cover

(1) Remove the four screws holding the front cover ⑥.

(2) Take the front cover out for removal.

(3) Unplug the 5-pin connector P862 from the Programme Timer board PW-2112.

(4) Also, unplug the 11-pin connector P861 from the Programme Timer board PW-2112.

(5) Unplug the 12-pin connector of the key board from the Interface board PW-2118.

6. Removing the Programme Timer board (as shown in Fig. 5-11, 5-12)

(1) Remove the knob from the Programme memory switch ⑨.

(2) Open the two tabs holding the Programme Timer board ③ one by one in the arrow (⇦ ⇨) direction.

(3) Take the board out for removal.

7. Removing the key board (as shown in Fig. 5-12)

(1) Remove the two screws ② holding the key board ①.

(2) Take the key board out for removal.

Assembling

Reverse Steps 1 through 7.

5-1-3 How to Replace the Tuner Block (see Figure 5-13)

To replace or remove the Tuner Block, proceed as follows.

1. Remove the four screws ② holding the Tuner Block ①.
2. Move the Tuner Block ① away from the VTR body.
3. Unplug the 15-pin connector ③ from the Antenna Terminal board.
4. Unplug the 6-pin connector ④ from the interface board PW2118.
5. To reassemble, reverse steps 1 through 4.

CAUTION:-The cabinet must be removed before replacing the Tuner Block.

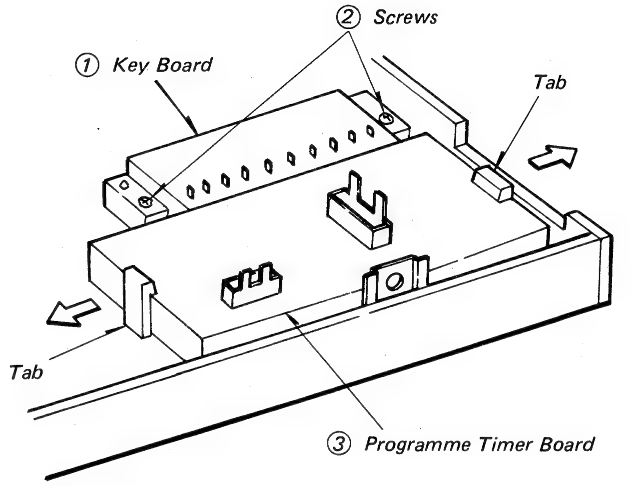


Fig. 5-12 Programme Timer Board and Key Board Removal

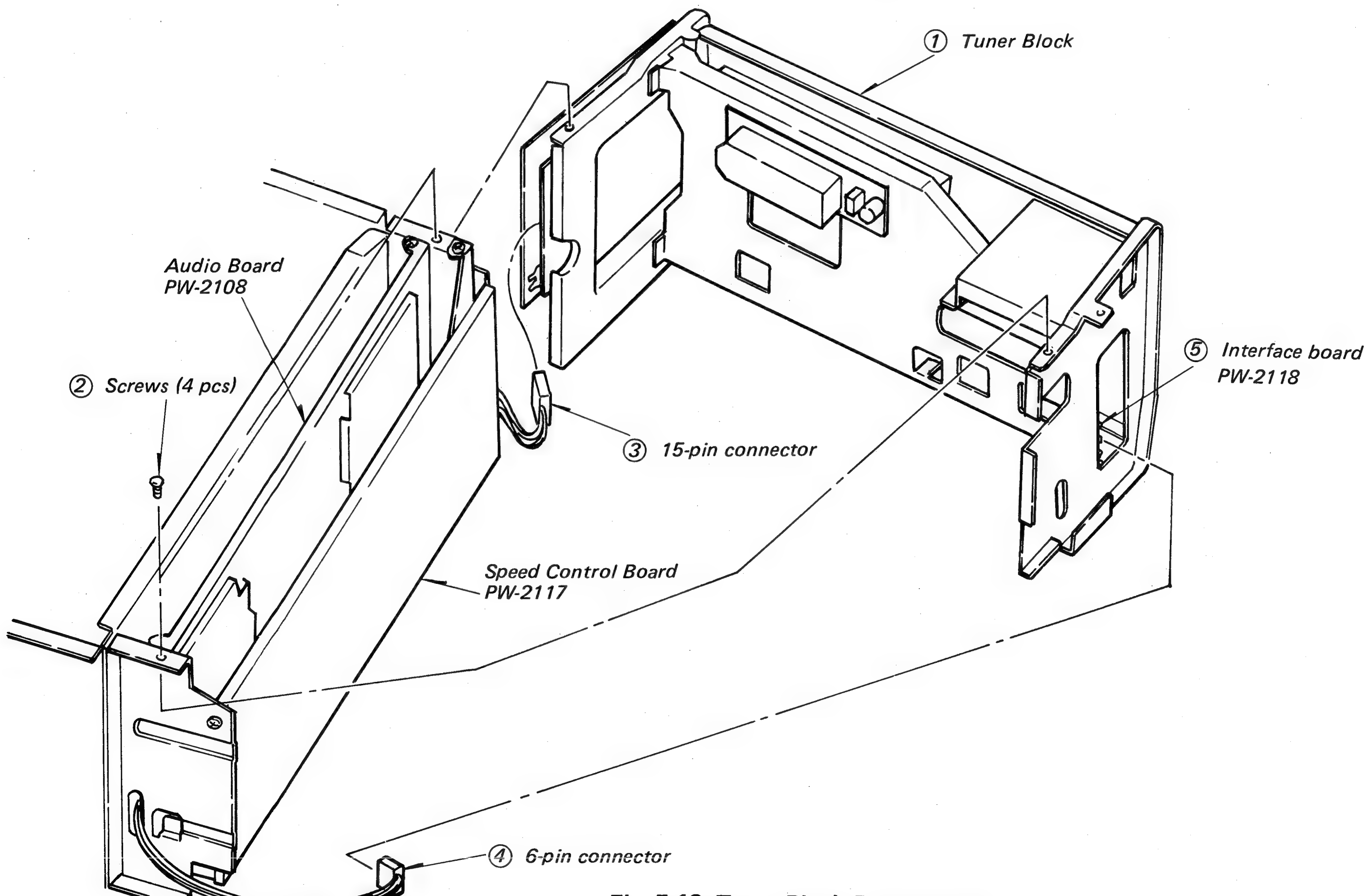


Fig. 5-13 Tuner Block Replacement

5-1-4 How To Install the Cassette after Removing the Cassette compartment

To install the cassette with the cassette compartment removed, proceed as follows.

1. Remove the top cover as directed in Section 5-1-2, the "How To Remove the Cabinet".
2. Remove the cassette compartment.
3. Turn the FUNCTION switch to the OFF (or TIMER) position while holding the lifter up.
4. Open the cassette lid ① using a Bladed screwdriver through the hole as illustrated in Fig. 5-14, and install the cassette ② on the reel tables.
5. Put a weight of 600 to 1,000 gr onto the cassette.
6. Turn the FUNCTION switch to the ON position.

To unload the cassette, proceed as follows.

1. Hold the EJECT button depressed until tape unloading ends.
2. Depressing the button, turn the FUNCTION switch to the OFF position.
3. Release the button.
4. Remove the weight.
5. Take the cassette out.

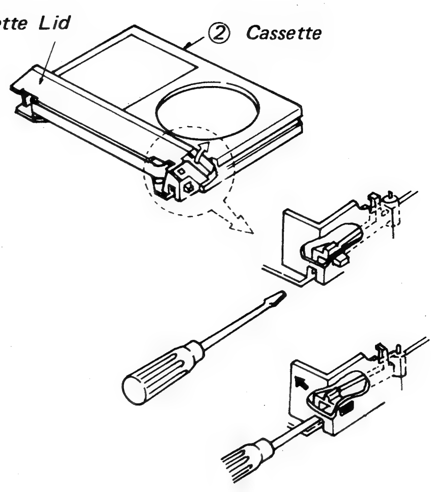


Fig. 5-14 Cassette on Which Lid is Opened.

5-1-5 How To Operate in Any Mode Without Cassette

To operate the VTR in a desired mode without cassette, proceed as follows.

1. Remove the top cover as directed in Section 5-1-2, the "How To Remove the Cabinet".
2. Turn the FUNCTION switch to the OFF (or TIMER) position.
3. Depress the cassette detect lever. (Depressing the cassette detect lever produces the loading ring which is unlocked.)
4. Press the record safety bracket down to lock the cassette compartment as illustrated in Fig. 5-15. (Pressing the record safety bracket produces the loading signal which moves the loading ring.)
5. This allows the VTR to operate in any mode other than the recording, playback, and audio dub modes.
6. For operation in the record playback, or audio dub mode, secure the slack lever so that it cannot function in tape slack detection.

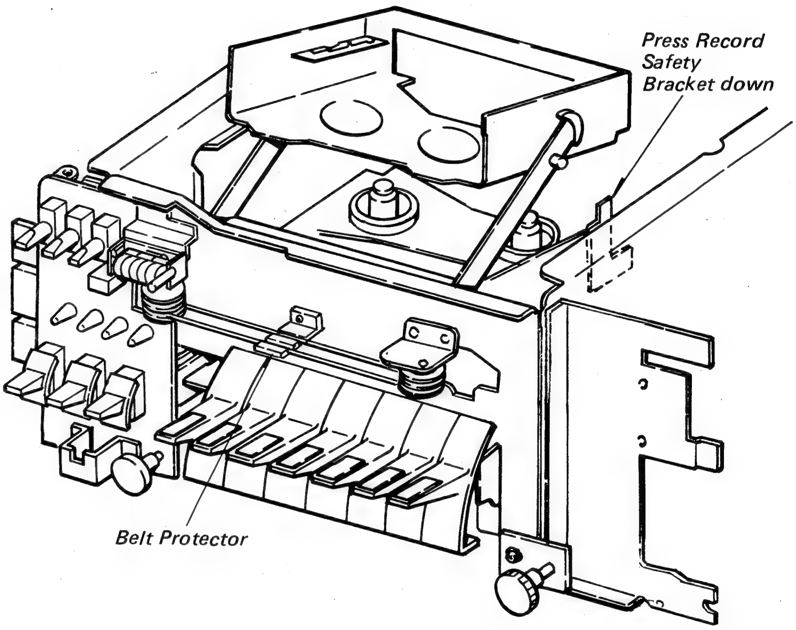


Fig. 5-15 Setting for Operation without Cassette.

5-2 MECHANICAL ADJUSTMENT AND REPLACEMENT

5-2-1 Replacing the Cassette Compartment

Removal

1. Remove the "E" ring ④ on the left side of the post on the cassette compartment ①.
2. Pull one end of the link ③ outward from the post, and turn it in the arrow (⇧) direction as shown in Fig. 5-16 for removal of the link ③ from the lifter bracket (L) ⑤.
3. Take the bias spring ⑥ out of the post on the cassette compartment ①.
4. Move the cassette compartment ① forward (toward the rear cover) and separate the end of each lifter ② (in the arrow (⇦ ⇨) directions) as shown in Fig. 5-17 for removal.

Installation

1. Open the end of each lifter ② (in the arrow (⇦ ⇨) directions) to put the cassette compartment ① in place.
2. Install the bias spring ⑥ on the post on the cassette compartment ①.
3. Mount the link ③ in place by fitting one end on the lifter bracket (L) ⑤ and other on the cassette compartment ① in this sequence.
4. Mount the "E" ring ④ in place.

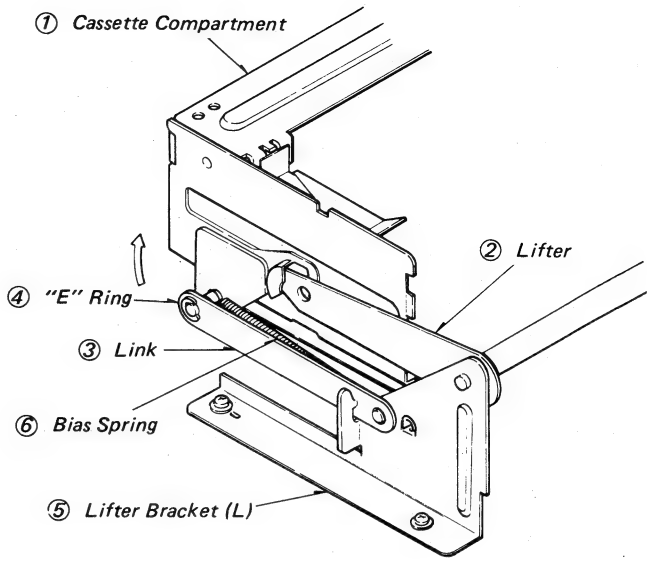


Fig. 5-16 Cassette Compartment Removal and Installation (1).

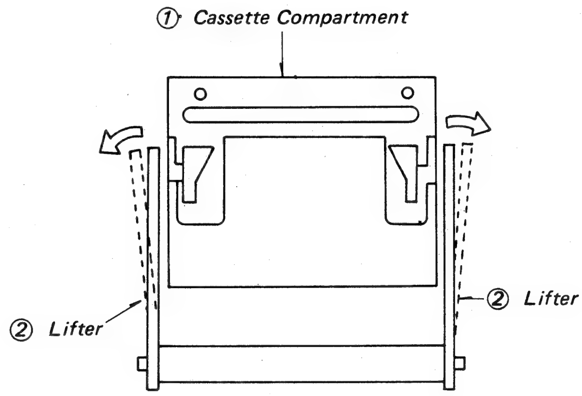


Fig. 5-17 Cassette Compartment Removal and Installation (2).

5-2-2 Replacing the Blinder (see Fig. 5-18)

Removal

1. Remove the cassette compartment as directed in Section 5-2-1, "Replacing the Cassette Compartment".
2. Remove the screw ③ shown in Fig. 5-18.
3. Move the blinder in the arrow 1 and 2 directions in Fig. 5-18 for removal.

Installation

1. Reverse Steps 1 through 3 above.
2. Check to insure that the blinder maintains proper contact at points Ⓐ, Ⓑ and Ⓒ.
3. Lightly tighten the screw and check to insure that blinder is not loose. Do not tighten excessively, or the threaded mold could be damaged.

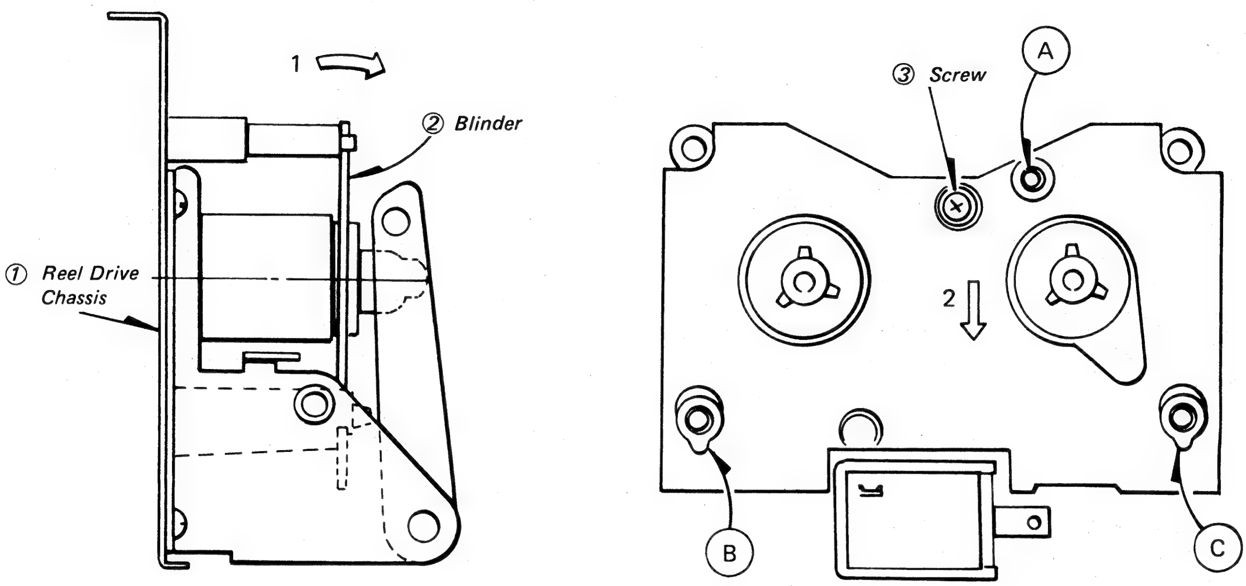


Fig. 5-18 Blinder Removal and Installation.

5-2-3 Checking the Cassette (TAPE) Loading State

1. Remove the cassette compartment cover.
2. Load a cassette into the cassette compartment.
3. Press the cassette by hand to check whether or not the cassette is free.
4. If normal, replace the cassette compartment cover.
5. If the cassette does not fit well, proceed as follows.
   a. Replace the cassette retainer springs (R) and (L) if they do not press the cassette well. For details, refer to Section 5-2-4, the "Replacing the Cassette Retainer Spring".
   b. Replace the lifters (R) and (L).
   To replace, proceed as follows:
   - Lock the cassette compartment without the cassette.
   - Fully lock the locker by pressing the record safety bracket down.
   - If there is no clearance between the top of the reinforcing beat on the bottom of the cassette compartment and the cassette retaining posts (left two, looking toward the cassette removal side), replace the lifters (see Fig. 5-19)

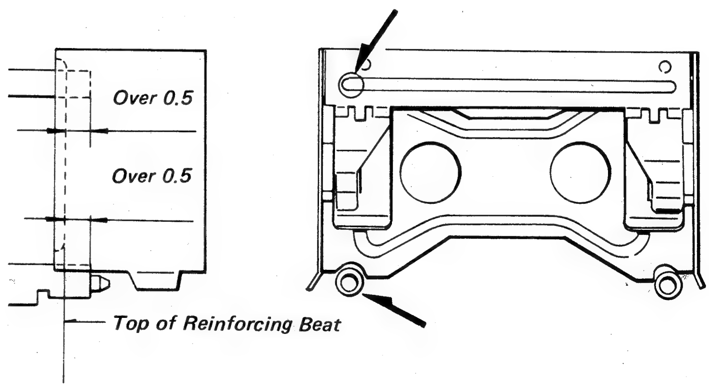


Fig. 5-19 Cassette Loading State Checking

5-2-4 Replacing the Cassette Retainer Springs

Removal (see Fig. 5-20)

1. Remove the cassette compartment cover.
2. Put a small bladed screwdriver into the portion Ⓐ.
3. Pry up portion Ⓐ. The cassette retainer spring may be removed easily.

Installation (see Fig. 5-21)

1. First, insert the pawl of the cassette retainer spring ② into the portion Ⓑ.
2. Strongly press the screwdriver on portion Ⓑ. The spring will be locked with a click.

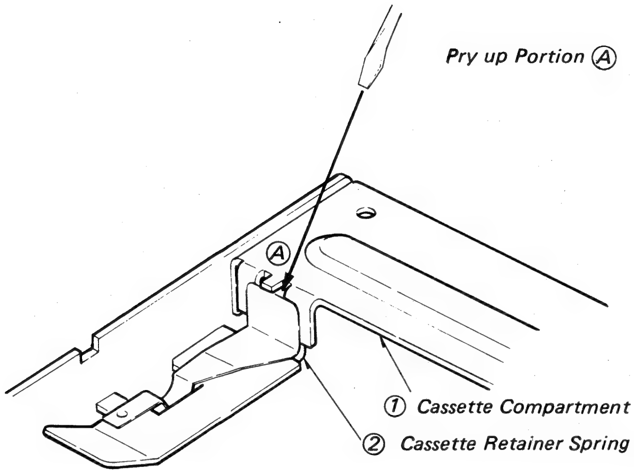


Fig. 5-20 Cassette Retainer Spring Removal.

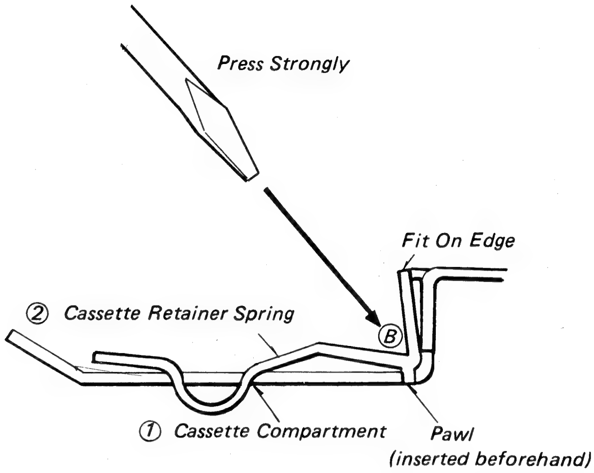


Fig. 5-21 Cassette Retainer Spring Installation.

5-2-5 Replacing the Cassette Compartment Lifters (see Fig. 5-22)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette compartment".
2. Remove the blinder as directed in Section 5-2-2, the "Replacing the Blinder".
3. Loosen the two screws holding the lifter bracket (L) looking toward the front panel.
4. Take the lifter ① out of the lifter brackets (L) and (R) each, and place it in the position shown in Fig. 5-22.
5. Take the lifter spring ② out of the hookⒶ.
6. Remove the lifter ①.
7. To replace the lifter ①, reverse Steps 1 through 6.

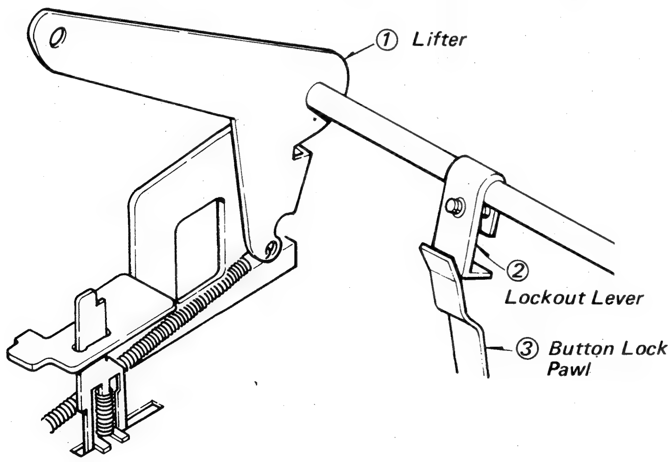


Fig. 5-23 Lifter Installation With Lockout Lever and Button Lock Pawl in Place.

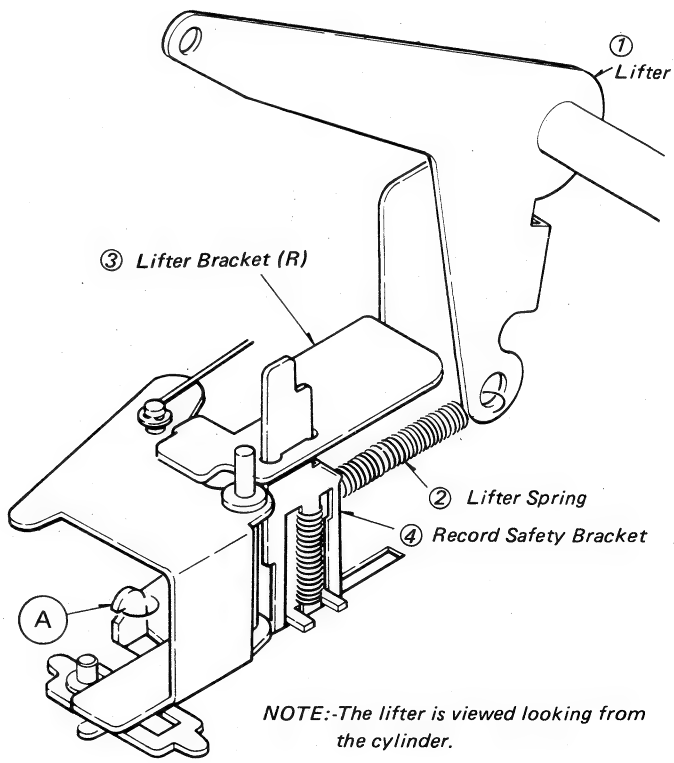


Fig. 5-22 Lifter Replacement.

NOTE:-In installing, the lockout lever and lock button pawl should be related as illustrated here.

5-2-6 Checking the Tape Loading Operation

If the lead switch, locker, or the magnet associated with the tape loading assembly arrangement is not adjusted properly, it will cause no tape loading or loading operation without tape. Checking the loading operation, therefore, is necessary.

Procedures

1. Turn the FUNCTION switch to the ON position.
2. Put the cassette into the cassette compartment, and press it down.
3. When the cassette compartment is locked, make certain that the tape is loaded.
4. Also when the cassette compartment is locked without the cassette, make certain that the loading ring has not rotated.

Adjustment

If the tape is not loaded normally, preceed as follows:

1. Adjust the lead switch as will be directed in Section 5-2-7, the "Adjusting the Lead Switch".
2. If loading is not normal yet, replace the lead switch as it is defective.
3. If the magnet is defective, replace the magnet as will be directed in Section 5-2-8, the "Replacing the Locker and Magnet".

5-2-7 Adjusting the Lead Switch (see Fig. 5-24)

1. Loosen the screw ①.
2. Fully pull the switch bracket ② toward the front panel.
3. Lightly tighten the screw ①.
4. Pry the switch bracket ② with a Bladed screwdriver. Put in the rectangular hole to move it in the arrow (⇨) direction.
5. Put the cassette into the cassette compartment and press it down.
6. Turn the FUNCTION switch to the ON position.
7. Adjust the switch bracket ② position until the tape is loaded.
8. Shift the switch bracket ② about 1 mm away from the loading position.
9. Firmly tighten the screw ①.
10. Take the cassette out of the cassette compartment and make certain that the tape loading assembly is not in the loaded position.
11. Also, make certain that the gap between the lead switch ③ and locker ④ is 0.5 to 1 mm when the cassette compartment is locked.

5-2-8 Replacing the Locker and Magnet

Locker (see Fig. 5-25)

1. Remove the lead switch.
2. Take the locker spring ① out of the lifter bracket (R) ②.
3. Remove the "E" ring ③.
4. Disconnect the eject wire ④ from the eject arm ⑤.
5. Remove the "E" ring ⑥ for removal of the locker ⑦.
6. To replace, reverse Steps 1 through 5.

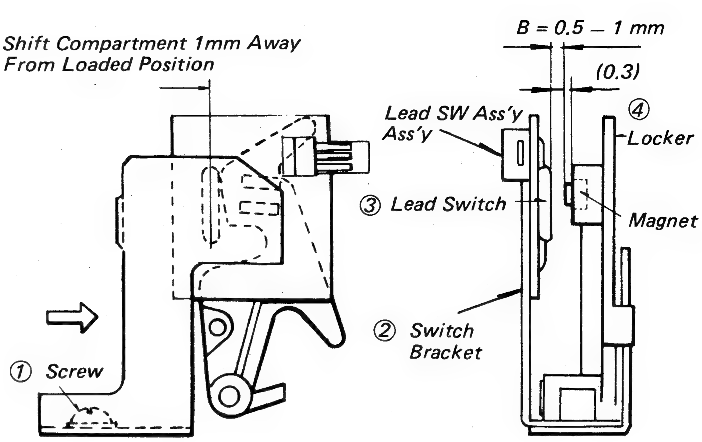


Fig. 5-24 Reed Switch Adjustment.

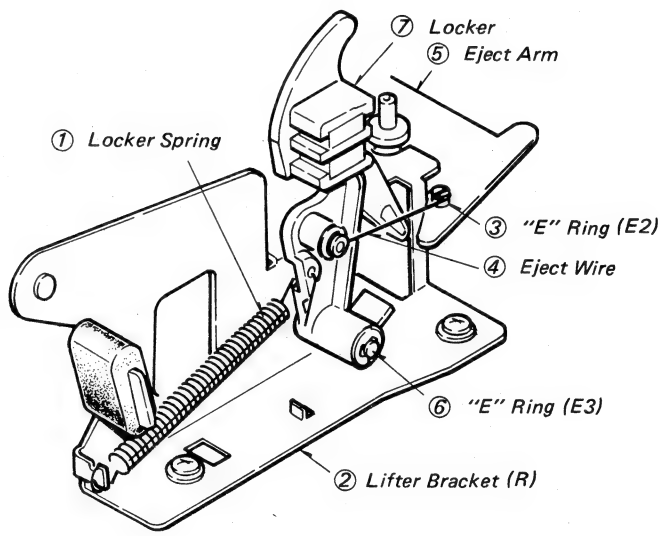


Fig. 5-25 Locker Replacement.

Magnet (see Fig. 5-26)

1. Remove the lead switch.
2. Remove the locker as directed above.
3. Widen the magnet holding portions at the end of the locker in the arrow directions.
4. Take the magnet out of the rear side of the locker.
5. To replace, reverse Steps 1 through 4.

CAUTION:-After installation of the magnet, apply a small quantity of rubber cement for secure holding.

5-2-9 Checking the Cassette Eject Operation

Misalignment of the cassette eject assembly creates a condition in which the EJECT button cannot be reset even when the cassette compartment is lifted up, or unloading operation which has ended is followed by another loading operation. Checking the eject operation, therefore, is necessary.

Procedures

1. Set the FUNCTION switch to the OFF position.
2. Put a cassette into the cassette compartment and press down to lock.
3. Depress the EJECT button slowly, or at a speed of 3 to 5 mm/sec., and check to insure that the cassette compartment lifts up.
4. Also, check to insure that the EJECT button is unlocked when the cassette compartment has risen to the "EJECT" position.
5. Allow the cassette to be loaded and at the end of tape loading, depress the EJECT button for unloading operation.
6. Check to insure that the loading ring is not in the loading operation when the cassette compartment has been lifted up at the end of unloading.

Adjustment (see Fig. 5-27)

If the tape unloading operation is not normal, proceed as follows:

1. Put a Phillips screwdriver through the hole on the front frame ① and loosen the screw inside the hole.
2. Adjust the lockout lever ② until its tip is 1 to 5 mm away from the front frame ①.
3. Firmly tighten the screw.

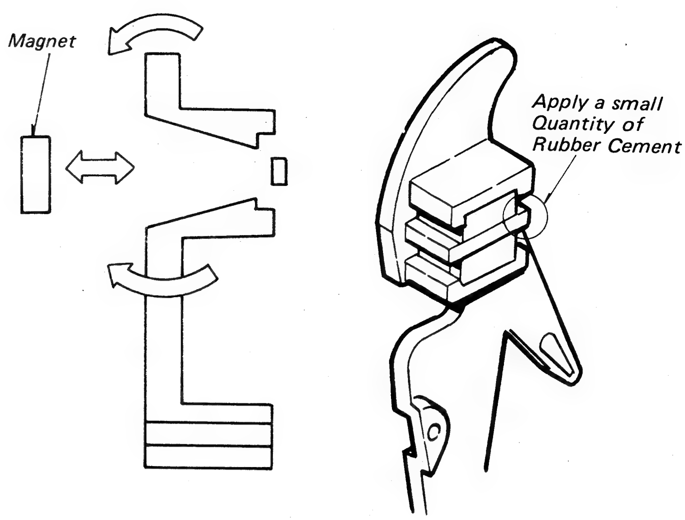


Fig. 5-26 Magnet Replacement.

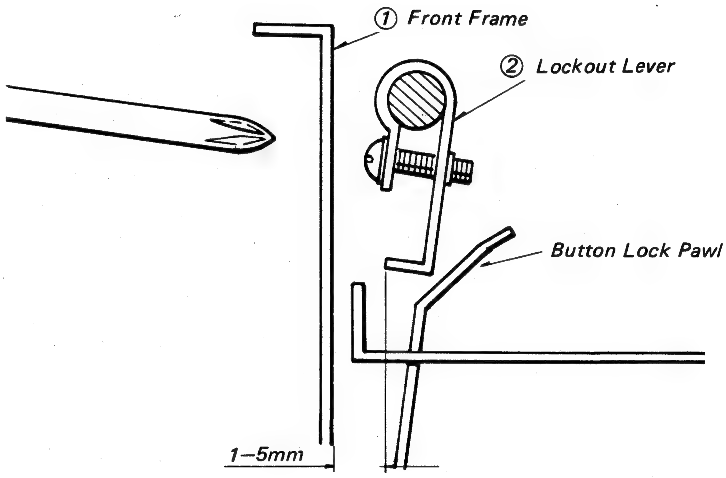


Fig. 5-27 Cassette Eject Adjustment

5-2-10 Checking and Adjusting the Reel Tables

If the reel tables are not at the specified height, this causes the tape to tangle in the cassette. Such tangling fluctuates tape tension on the next run, resulting in low quality playback or recording.

Checking

To check the reel table height, proceed as follows:

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Mount a cassette reference plate ② in place on the reel drive chassis as shown in Fig. 5-28.
3. Make certain that when the slider Z ③ on the cassette reference plate ② is slid right and left in the arrow (⇦) direction, step A of the slider Z will not touch each reel table assembly ①, but the bottom B will catch it.

Adjustment

If the reel table is not at the specified height, proceed as follows:

1. Add or subtract the height adjustment washers ③ and ⑥ (refer to Fig. 5-29 and 5-30).
2. Repeat checking stated in Step 3 above.

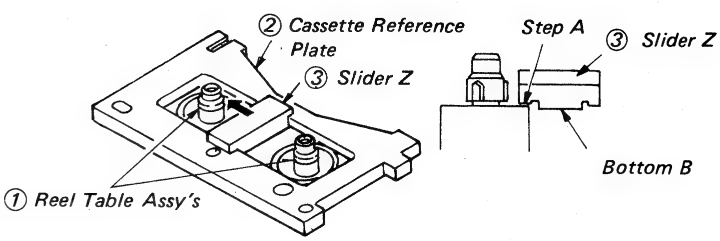


Fig. 5-28 Checking Reel Table Height.

5-2-11 Replacing the Supply Reel Table (see Fig. 5-29)

1. Remove the supply reel table ①. In removing, be careful not to damage the brake band ②. Note that the washer ③ or ⑥ or thrust bearing ④ may stick on the reel table ①.
2. Wipe the reel table post ⑤ clean with a cloth dampended in isopropyl alcohol.
3. Wait for it to dry, and apply a few drops of oil to it using the oil injection kit.
4. To replace the supply reel table ① reverse Steps 1 through 4.
5. Check and adjust the supply reel table ① as directed in Section 5-2-10, the "Checking and Adjusting the Reel Tables".

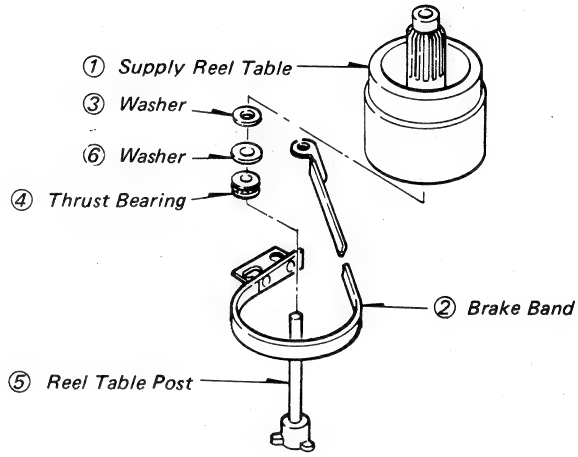


Fig. 5-29 Supply Reel Table Assembly.

5-2-12 Replacing the Take-up Reel Table (see Fig. 5-30)

1. Remove the counter belt ② from the groove of the take-up reel table ①.
2. Remove the take-up reel table ① from the reel table post ⑤. Note that the washer ③ or the detect plate dummy ⑥ or the thrust bearing ④ may be stuck on the reel table ①.
3. Replace the take-up reel table ① on the reel table post ⑤.
4. Check and adjust the take-up reel table ① as directed in Section 5-2-10, the "Checking and Adjusting the Reel Tables".
5. Tighten the set screw on the take-up reel table ①.
6. Put the counter belt ② on the groove of the take-up reel table ①.

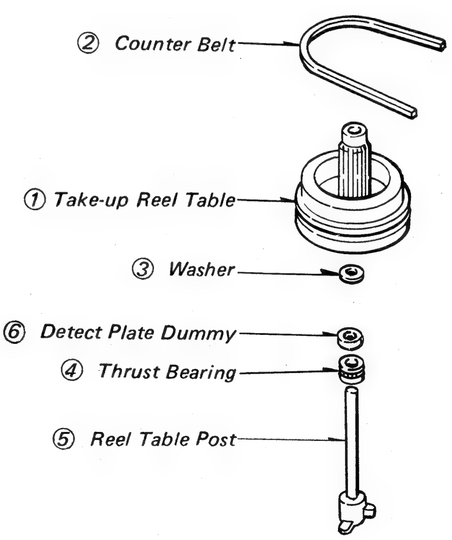


Fig. 5-30 Take-up Reel Table Assembly.

5-2-13 Checking and Adjusting the Tension Lever in Unloading State (see Fig. 5-31)

Improper adjustment of the tension lever in the unloading state could damage the tape or sometimes causes tension lever does not pull out the tape from the cassette in the loading operation. To prevent such a malfunction, check and adjust the tension lever as follows.

Checking

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Depress the EJECT button to unload the tape.
3. Install the cassette reference plate ① in place on the reel drive chassis.
4. Check to insure that the gap between the end of the tension lever ② and cassette reference plate ① is 0.5 to 1.0 mm.

Adjustment

If the tension lever ② is not aligned well as specified above, proceed as follows:

1. Loosen the screw ④ holding the shift lever ③.
2. Pressing the end of the shift lever ③ with a finger, move it in the arrow A or B direction with a screwdriver or similar tool hooked in the adjust hole.

NOTE:-Moving in the A direction makes the gap narrow.
Moving in the B direction makes the gap wide.

3. After adjustment, tighten the screw ④.

5-2-14 Checking and Adjusting the Tension Lever in Playback Mode (see Figs. 5-32, -36)

Checking

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Turn the FUNCTION switch to the ON position.
3. Lock the lifters and press the record safety bracket down to load the tape.
4. Fit the tension regulator forward position jig ① on the height aligning shafts ② and ③.
5. Check to insure that the clearance between the tension regulator forward position jig ① and tension lever ⑤ is 0.05 to 0.4 mm when the supply reel table ④ is turned in the arrow (⇦) direction.

Adjustment

If the tension lever ⑤ is not aligned well as specified above, proceed as follows:

1. Loosen the screw ⑥.
2. Move the tension lever ⑤ in the A direction for narrow clearance, or move it in the B direction for wide clearance. (see Fig. 5-36.)
3. After adjustment, firmly tighten the screw ⑥.

NOTE:-Tension Sub-Lever Adjustment
Overlap of the tension sub-lever ① and the stopper ② should be adjusted within from 0.5 to 1.5mm width.
When proceeding adjustment, use the long hole, loosening a screw which screws the tension sub-lever to the tension lever.

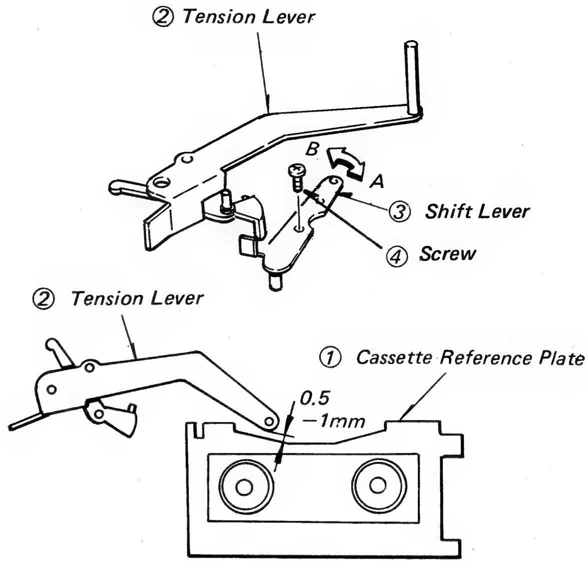


Fig. 5-31 Tension Lever Checking in Unloading State.

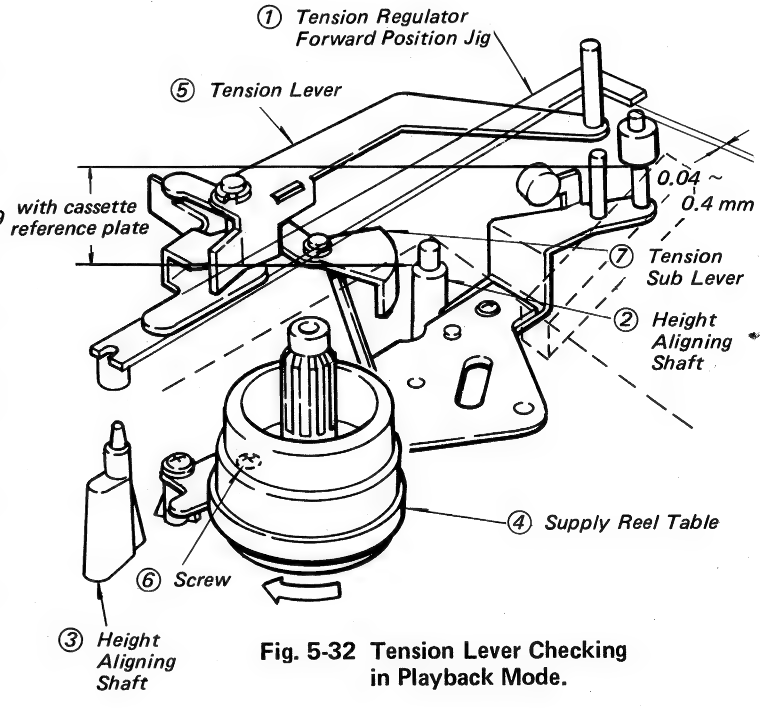


Fig. 5-32 Tension Lever Checking in Playback Mode.

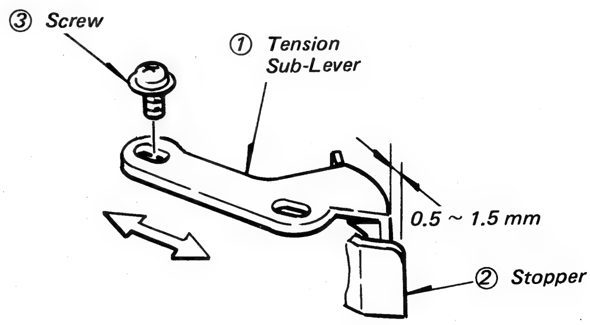


Fig. 5-33 Tension Sub-Lever Adjustment

5-2-15 Removing the Tension Lever (see Fig. 5-34)

1. Leaving the cassette compartment removed the "E" ring ⑤ and tension spring ⑥.
2. Remove the tension lever ④, polyethylene slider ③, and tension release lever ①.
3. Replace the tension lever ④ by reversing Steps 1 and 2. Note that in assembling, the hole of the tension release lever ① should be fitted on the pin of the eject connector ②.

CAUTION:-Be careful not to bend the post in removing and fitting the "E" ring as it could be broken. Lateral pressure to the post should not be higher than 3 kg.

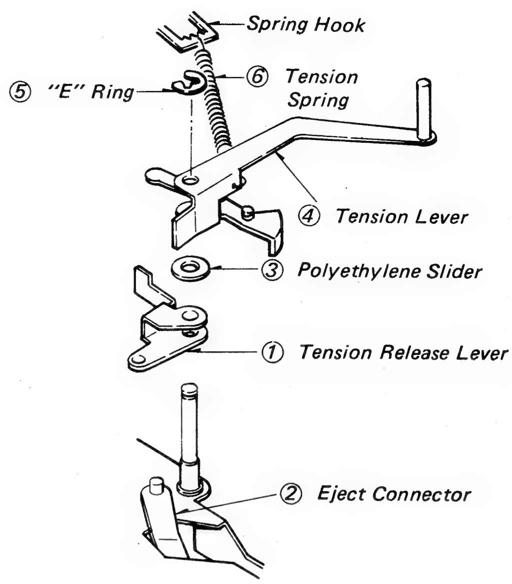


Fig. 5-34 Tension Lever Assembly.

5-2-16 Checking and Adjusting the Back-Tension in Recording and Playback Modes

In the record or playback mode of operation, the tape is pulled back, or given a back-tension. This always keeps a uniform tension on the tape and to assures stable tape running. Excessive back-tension results in elongation of the tape and too low back-tension causes hunting or floating of the tape without fitting close to each head. To prevent such a tape failure, check and adjust the back-tension as follows.

Checking (see Fig. 5-35)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Install the tension alignment jig ③ on the right-hand chassis.
3. Turn the FUNCTION switch to the ON position, and press the lifters down to lock.
4. Lower the record safety bracket downward to load the tape.
5. Mount the playback tension measuring jig ① in position on the supply reel table ②.
6. Run the tape through the tension alignment jig ③ as shown.
7. Depress the PLAY button.
8. Make certain that the supply reel brake is released, and check to insure that the back-tension is 40 to 50 grams when the tension gauge ④ is pulled at a rate of 1.8 cm/sec. Note that if the tension alignment jig ③ is used, the back-tension is 47 to 57 grams.

Adjustment

1. Change the tension spring ⑤ from one position to another on the spring hook ⑥ ; shift it in the A direction for weak back-tension or in the B direction for strong back-tension.

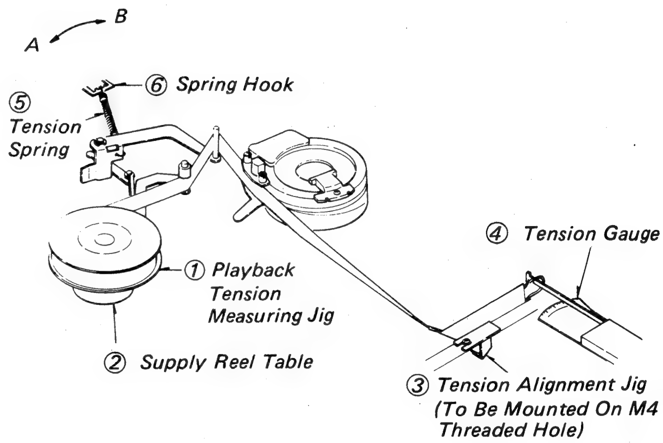


Fig. 5-35 Tape Back-Tension Measurement.

5-2-17 Replacing the Band Brake (see Fig. 5-36)

The tension lever detects the playback tension to apply the brake band to make the playback tension uniform. If the playback tension difference is not lower than 10 grams or varies largely between beginning and end of the tape, then be sure to replace brake band as directed below.

1. Remove the "E" ring ③ and screw ①.
2. Remove the brake band ②.
3. Assemble the brake band by reversing Steps 1 and 2 above.
4. Check and adjust the tension lever in the playback mode of operation as directed in Section 5-2-14.
5. Also, check and adjust the back-tension in the playback mode of operation as directed in Section 5-2-16.
6. Make certain that picture can be normally reproduced when the alignment tape is played back.
7. Also, make certain that the tape is free from any curl or floating when it is run.

5-2-18 Checking, Adjusting, and Replacing the Supply Brake

Checking and adjustment (see Fig. 5-37)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Depress the EJECT button.
3. Measure the torque of the supply brake ④ using the playback tension measuring jig ② and tension gauge 3 as directed below.
4. Mount the playback tension measuring jig ② in position on the supply reel table ①.
5. Make certain that when pulling the tape wound on the playback tension measuring jig ② with the tension gauge ③, the torque, read on the tension gauge ③ multiplied by the radius of the wound tape is higher than 100 g.cm.
6. If the specified torque cannot be obtained, replace the supply reel brake as directed below.

Replacement (see Fig. 5-38)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Remove the cover plate as directed in Section 5-2-2, the "Replacing the Blinder".
3. Take the spring ② of the supply brake ① out of the bracket ③.
4. Remove the supply brake ①.
5. Assemble the supply brake by reversing Steps 1 through 4.

CAUTION:-In replacement, be careful not to touch the rubber of the brake with your hand, nor to apply any oil to it.

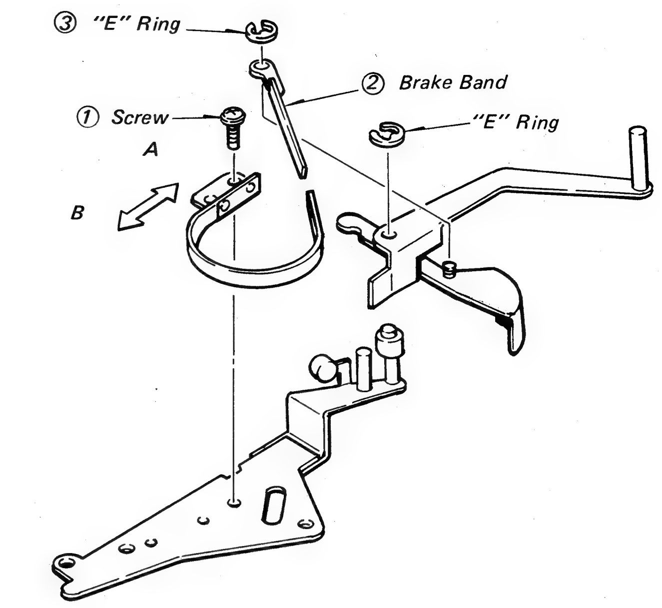


Fig. 5-36 Brake Band Assembly.

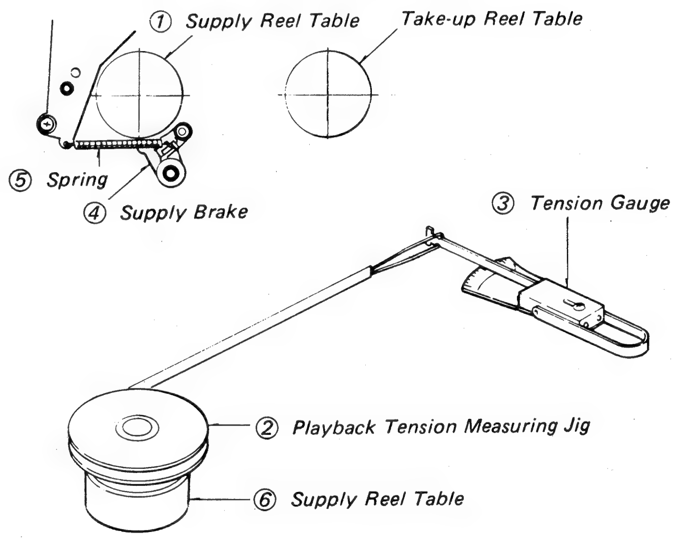


Fig. 5-37 Supply Brake Torque Measurement.

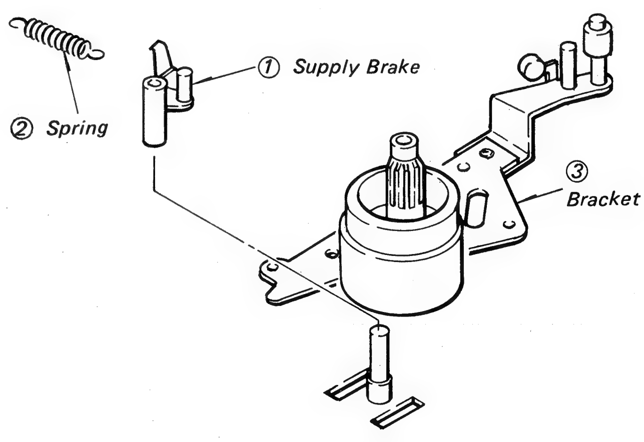


Fig. 5-38 Supply Brake Assembly

5-2-19 Checking and Adjusting the Take-up Torque in Record and Playback Modes

In the record or playback mode, the tape is fed from the supply reel and is wound by the take-up reel. If the torque of the take-up reel is too high, this causes excessive tension on the tape, resulting in elongation. To prevent such a high tension, check and adjust the take-up torque as follows.

Checking and adjustment (see Fig. 5-39)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Mount playback tension measuring jig ② in position on the take-up reel table ①.
3. Set up the VTR in the recording or playback mode.
4. Read the tension gauge ③ to make certain that the take-up torque is 60 to 160 g.cm.

NOTE:-If the T-type torque measurement cassette is used, make certain that it reads 60 to 160 g.cm.

5. If the specified torque cannot be obtained, replace the play idler.

NOTE:- T : take-up torque (g.cm)
D : diameter of tape (cm)
W : value of the tension gauge (g)

$$T = \frac{D}{2} \times W$$

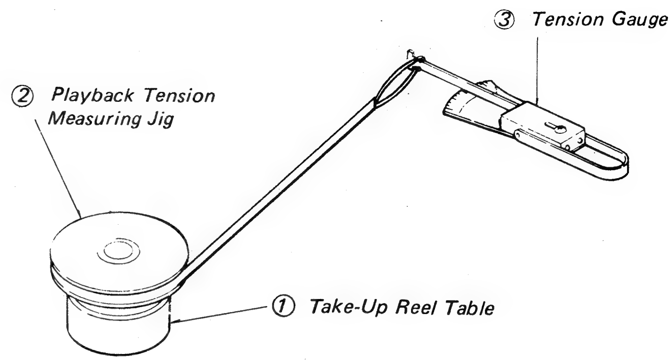


Fig. 5-39 Recording and Playback Take-up Torque Checking.

5-2-20 Replacing the Play Idler (see Fig. 5-40)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Remove the blinder as directed in Section 5-2-2, the "Replacing the Blinder".
3. Remove the play belt ③.
4. Lift the play idler ① upward for removal.
5. Replace the play idler by reversing Steps 1 through 4.
6. After replacement of the play belt, check the take-up torque in the playback mode as directed in Section 5-2-19.

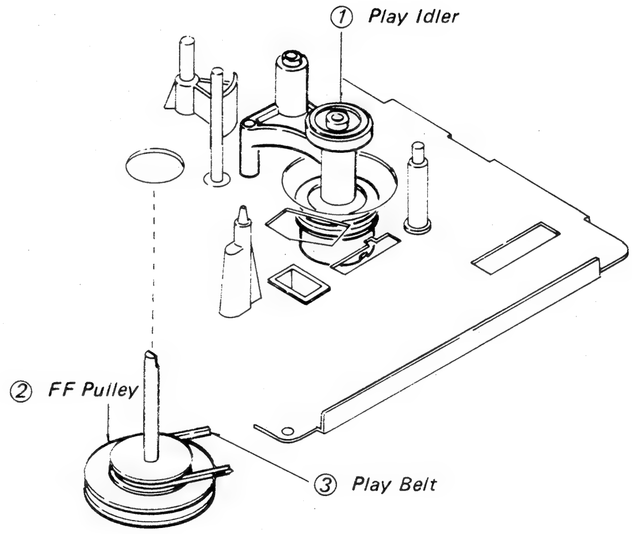


Fig. 5-40 Play Idler Replacement.

5-2-21 Checking and Adjustment of the Fast-Forward and Rewinding Torques with Tension Gauge (See Fig. 5-41, -42)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Mount the playback tension measuring jig ② in position on the take-up reel table ①.
3. Set up the VTR in the fast-forward mode by turning the FUNCTION switch to the ON position and depressing the FF/P.SEARCH button.
4. Make certain that when pulling the tape wound on the playback tension measuring jig ② with the tension gauge ③, the fast-forward torque, read on the tension gauge ③ multiplied by the radius of the wound tape, is higher than 600 g.cm.
5. Set the VTR in the rewind mode by depressing the REW/P.SEARCH button.
6. Similarly, make certain that the rewind torque is higher than 600 g.cm.

Checking with the FF/REW torque measurement cassette

1. Put a torque meter in place into the cassette compartment.
2. Set up the VTR in the fast-forward mode.
3. Read the torque meter to insure that the fast-forward torque is higher than 600 g.cm.
4. Set the VTR in the rewind state. Make certain that the rewind torque is higher than 600 g.cm.

Adjustment

1. Clean the supply reel table, take-up reel table, rewinding idler, fast-forward idler, fast-forward pulley, fast-forward and rewinding belt, intermediate flat belt, and intermediate pulley.
2. If the rewind idler or fast-forward idler are worn, replace them.
3. If a belt is stretched too much, replace it.

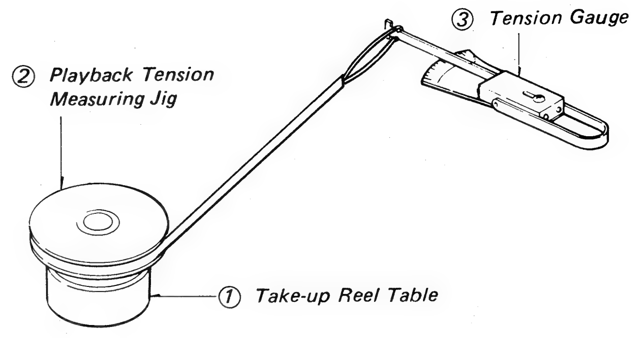


Fig. 5-41 Checking Fast-Forward Torque.

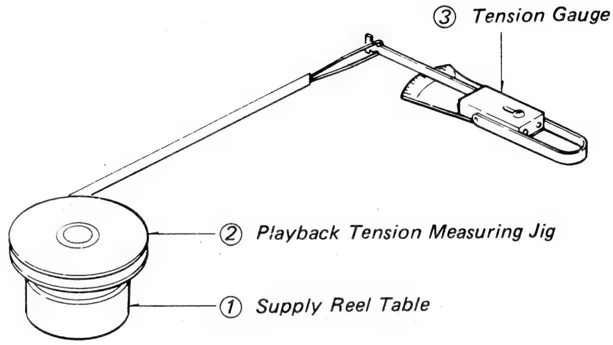


Fig. 5-42 Checking Rewinding Torque.

5-2-22 Replacing the Fast-Forward Idler (see Figs. 5-43, -44)

1. Remove the Video Circuit board PW-2109 located at the bottom of the main body.
2. Remove the push button assembly.
3. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
4. Remove the blinder as directed in Section 5-2-2, the "Replacing the Blinder".
5. Remove the belts ⑦ and ⑨.
6. Remove the "E" ring ①.
7. Remove the fast-forward idler ②.
8. Take the spring ⑩ out of the hook on the reel chassis.
9. Also, remove the "E" ring ⑤ and take out the fast-forward lever ④.
10. Incline and take the fast-forward lever ④ out toward the position where the push button assembly has been installed (see Fig. 5-44).
11. Assemble the fast-forward idler by reversing Steps 1 through 10.

CAUTION 1:-Care should be observed not to miss the polyethylene sliders ③ and ⑥.

2:-Be sure to clean the rubber surface of the fast-forward idler ②, groove of the fast-forward pulley ⑧, and belts ⑦ and ⑨ using the cleaning kit.

3:-Apply oil sparingly to the shaft of the fast-forward pulley using the oil injection kit.

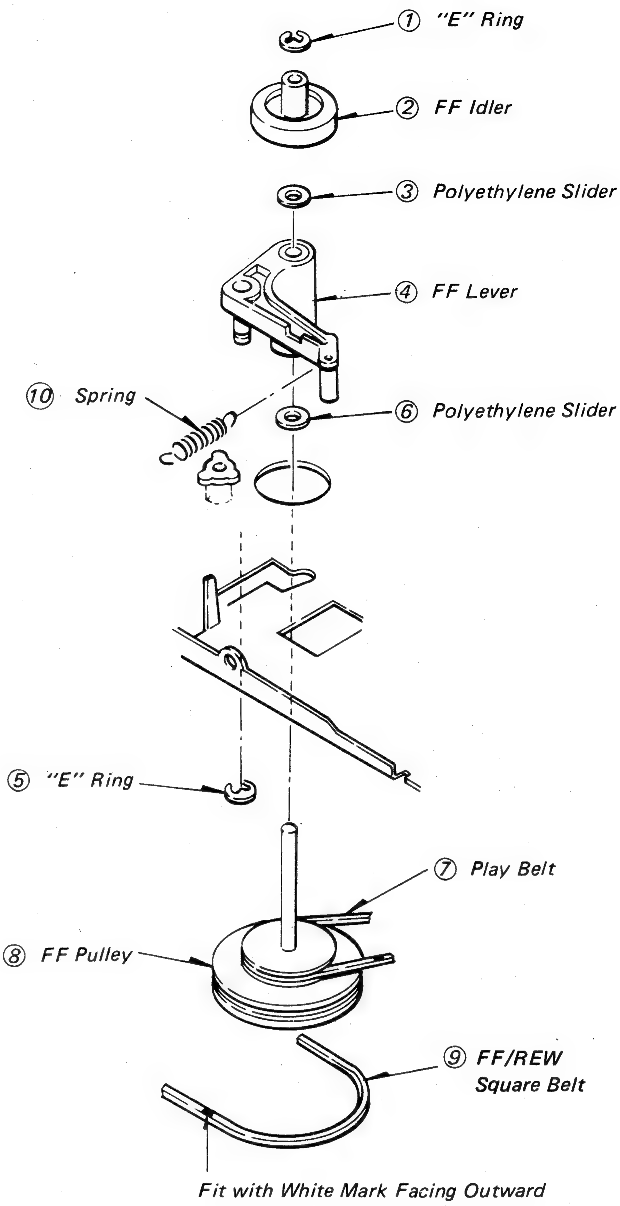


Fig. 5-43 Fast-Forward Idler Assembly.

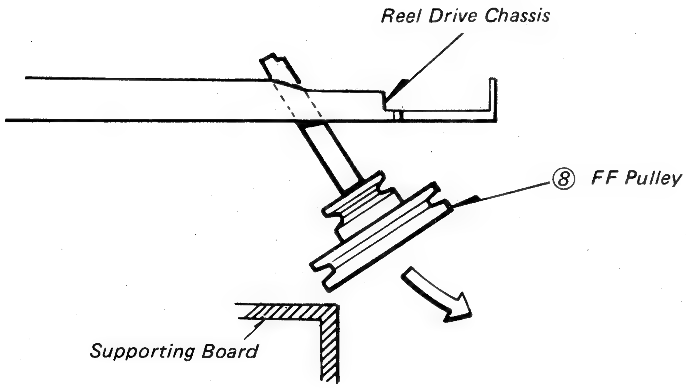


Fig. 5-44 Fast-Forward Pulley Removal.

5-2-23 Replacing the Rewinding Idler (see Figs. 5-45, -46)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Remove the blinder as directed in Section 5-2-2, the "Replacing the Blinder".
3. Depress the EJECT button.
4. Unhook the Rew Idler Spring ② on the Rew idler ①.
5. Take out the Rew idler ① as shown in Fig. 5-45.

Note:
In this case, the FF idler is closed to the Take-up Reel Table.

6. Remove the "E" ring ③.
7. Replace the Rew idler ④.
8. Assemble the rew idler by reversing Steps 1 through 6. through 6.

CAUTION 1:-Care should be observed not to miss the polyethylene sliders ⑤ and ⑥.
2:-Be sure to clean the rubber surface of the REW idler ④ using the cleaning kit.
3:-Apply oil sparingly to the shaft of the fast-forward pulley using the oil injection kit.

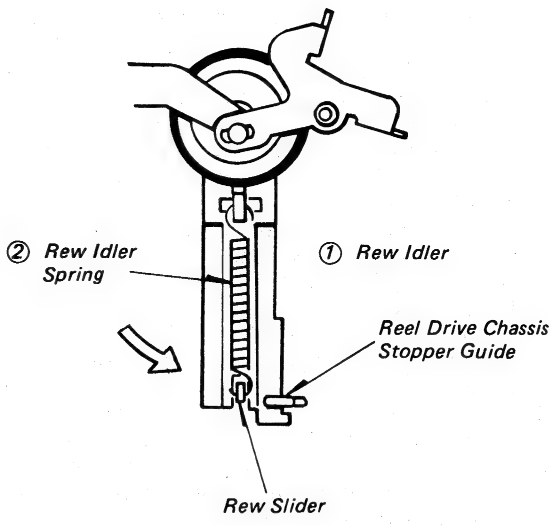


Fig. 5-45 Rew Idler Removal.

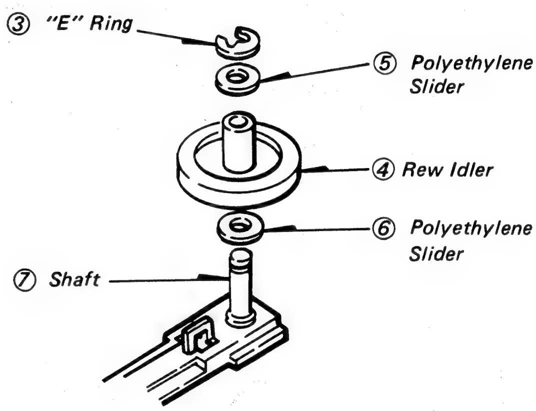


Fig. 5-46 Rew Idler Assembly.

5-2-24 Checking the Fast-Forward Brake Torque (see Fig. 5-47)

Improper torque of the Fast-forward brake causes slack in the tape in the fast-forward or rewinding state, also, results in an extended fast-forward or rewinding time. To prevent such a failure, check the fast-forward brake for torque as follows.

Checking

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Press the lifters down to lock.
3. Turn the FUNCTION switch to the OFF position.
4. Move the ring detect slider to the right.
5. Depress the FF/P.SEARCH button.
6. Mount the reel table tension gauge in position on the supply reel table.
7. Now, check to insure that when pulling the tape at a speed of 18.7 mm/sec., the fast-forward braking torque is 10 to 20 g.cm. Note that the torque is the product of the reading on the tension gauge multiplied by the radius of the tape wound on the playback tension measuring jig ②.

Adjustment

1. If the fast-forward braking torque is too low, cut the fast-forward brake spring 2 turns. But, do not cut it over 4 turns.
2. If the torque is too high, slightly expand the fast-forward brake spring. But, be careful not to expand it too much nor to deform it.
3. If the torque cannot be adjusted to the specified value yet, then replace the fast-forward brake as will be described below.

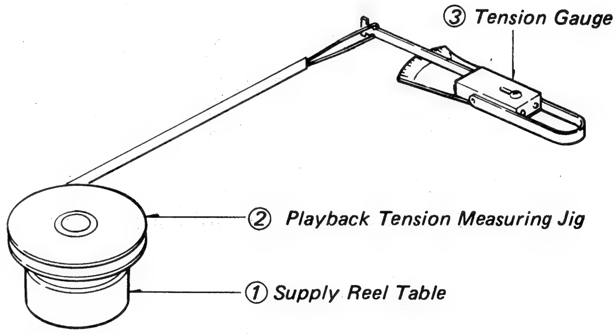


Fig. 5-47 Fast-Forward Brake Torque Checking.

5-2-25 Replacing the Fast-Forward Brake (see Fig. 5-48)

1. Remove the cassette compartment as directed in Section 5-2-1, the "Replacing the Cassette Compartment".
2. Remove the blinder as directed in Section 5-2-2, the "Replacing the Blinder".
3. Unhook the spring (1) from supply reel brake.
4. Unhook the spring (2) from the reel drive chassis.
5. Unhook the fast-forward brake (7) from the fast-forward connector (4).
6. Remove the "E" ring (5) and take out the fast-forward connector (4).
7. Take out the brake logic lever (6) and fast-forward brake (7) together.
8. Replace the fast-forward brake by reversing Steps 1 through 7.

CAUTION 1:-Be careful not miss the polyethylene slider (8).

2:-Keep the felt surface of the fast-forward brake (7) free from finger prints oil, and any other dirt.

3:-Be careful not to scratch the band brake when taking out the bracket (9). To protect the brake band against scratching, take out it before removing the bracket (9). Whenever the brake band is taken out and assembled, check the tension lever and back-tension according to Sections 5-2-14 and 5-2-16.

4:-The torque for tightening screw (10) should be 6 to 7 kg.cm.

5-2-26 Checking and Adjusting the Auto-Stop Solenoid

If the auto-stop solenoid stroke is not adjusted well, it cannot function to automatically stop, or release, an operating button at the time when (1) the tape comes to the end, (2) it reaches to the position specified by the Counter Memory, (3) tape slack is detected, (4) no revolution of the video head disk is due to tape sticking, (5) and so forth. To prevent such a failure, check and adjust the auto-stop solenoid as follows.

Checking

1. Put a cassette tape into the cassette compartment to load the tape.
2. Depress the FF/P.SEARCH, REW/P.SEARCH, PLAY, REC, or AUDIO DUB button.
3. Connect a 47 kΩ resistor across the Dew Sensor with shortening clips to force the solenoid activate the plunger.
4. Check whether each operating button can be released.

NOTE:-For checking, remove the top cover.

Adjustment (see Fig. 5-49)

If the operating button cannot be released by the plunger in the auto-stop solenoid, or if the plunger is not activated even when the solenoid is energized, adjust the solenoid position as follows.

1. Remove the top cover as directed in Section 5-1-2, the "How To Remove the Cabinet".
2. Remove the bottom cover as in Section 5-1-2.

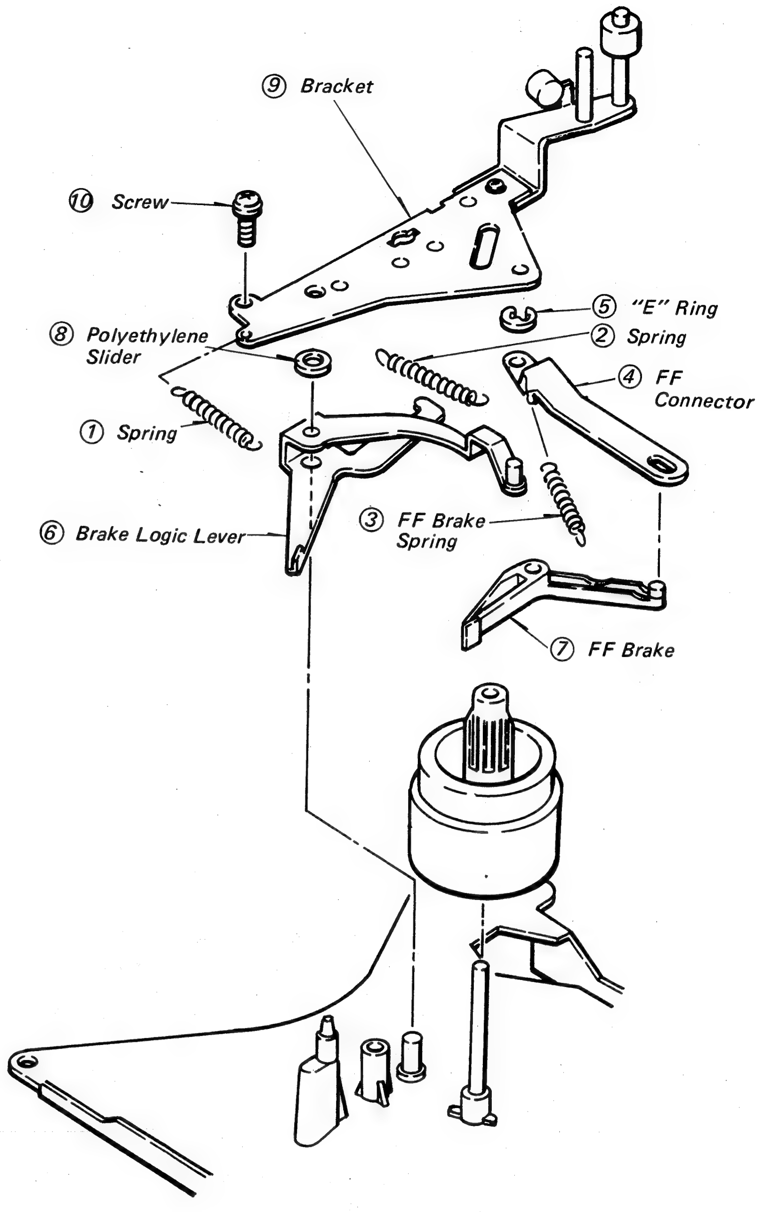


Fig. 5-48 Fast-Forward Brake Assembly.

3. Remove the front panel as in Section 5-1-2.
4. Loosen the two screws ④ holding the auto-stop solenoid ①.
5. Move the auto-stop solenoid ① to the end in the arrow (⇦) direction.
6. Lightly tighten the screws.
7. Hold the plunger activated in the auto-stop solenoid 1 by turning the FUNCTION switch to the ON position and short 47 kΩ resistor across the Dew Sensor.
8. Put a bladed screwdriver into the rectangular hole on the front chassis, gradually move the solenoid opposite the arrow until the tip of the button locker is moved as slight as 0.1 to 0.5 mm when the PLAY button is depressed several times.
9. Tighten the screws.
10. Check the auto-stop solenoid for action in accordance with the "Checking" procedures above.
11. Check to insure taht the capstan motor cannot revolve even when pressing any of the operating buttons when the plunger is attracted in.
12. After adjustment, assemble each part by reversing Steps 1 through 7.

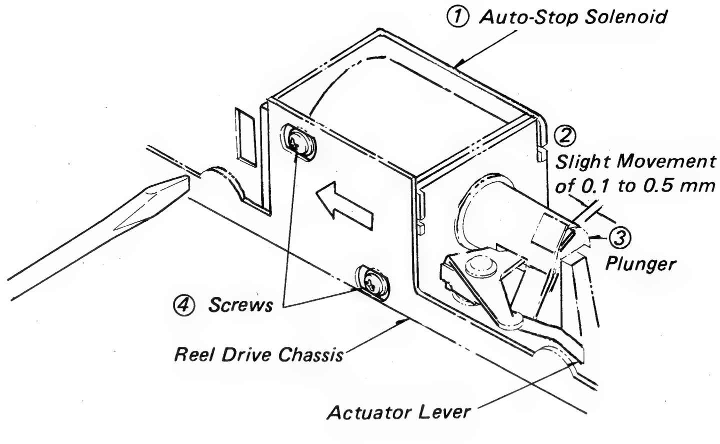


Fig. 5-49 Auto-Stop Solenoid Positioning.

5-2-27 Replacing the Push Button Block Assembly

1. Remove all the parts of the cabinet as directed in Section 5-1-2, the "How To Remove the Cabinet".
2. Unplug the connector from the Leaf Switch board (PW-1852).
3. Remove the four screws for removal of the push button assembly.
4. Assemble the push button assembly block by reversing Steps 1 through 3.

CAUTION:-In installing the push button assembly block, the button locker and lockout lever should be positioned as shown in Fig. 5-50.

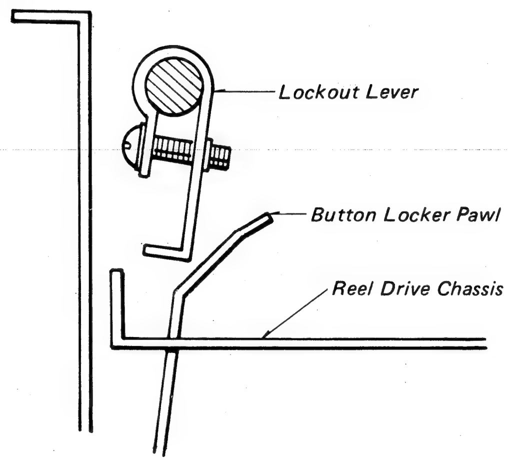


Fig. 5-50 Positional Relationship between Lockout Lever and Button Locker Pawl.

5-2-28 Replacement the Push Button Block Assembly (see Fig. 5-51)

1. Remove the push button block assembly as directed in section 5-2-27.
2. Remove the two screws ①.
3. Remove the Bracket assembly (R) ④ and bracket assembly (L) ⑤.
4. Remove the upper slider ass'y ②.
5. Remove the slider assembly ③.
6. Remove the four screws ⑨ for removal of the locker bracket assembly ⑥.
7. Remove button shaft ⑧ with the push button assembly of the button bracket assembly ⑦.
8. Remove the push button assembly ⑩ from the button shaft ⑧.
9. Assemble the push button block assembly by reversing steps 1 through 8.

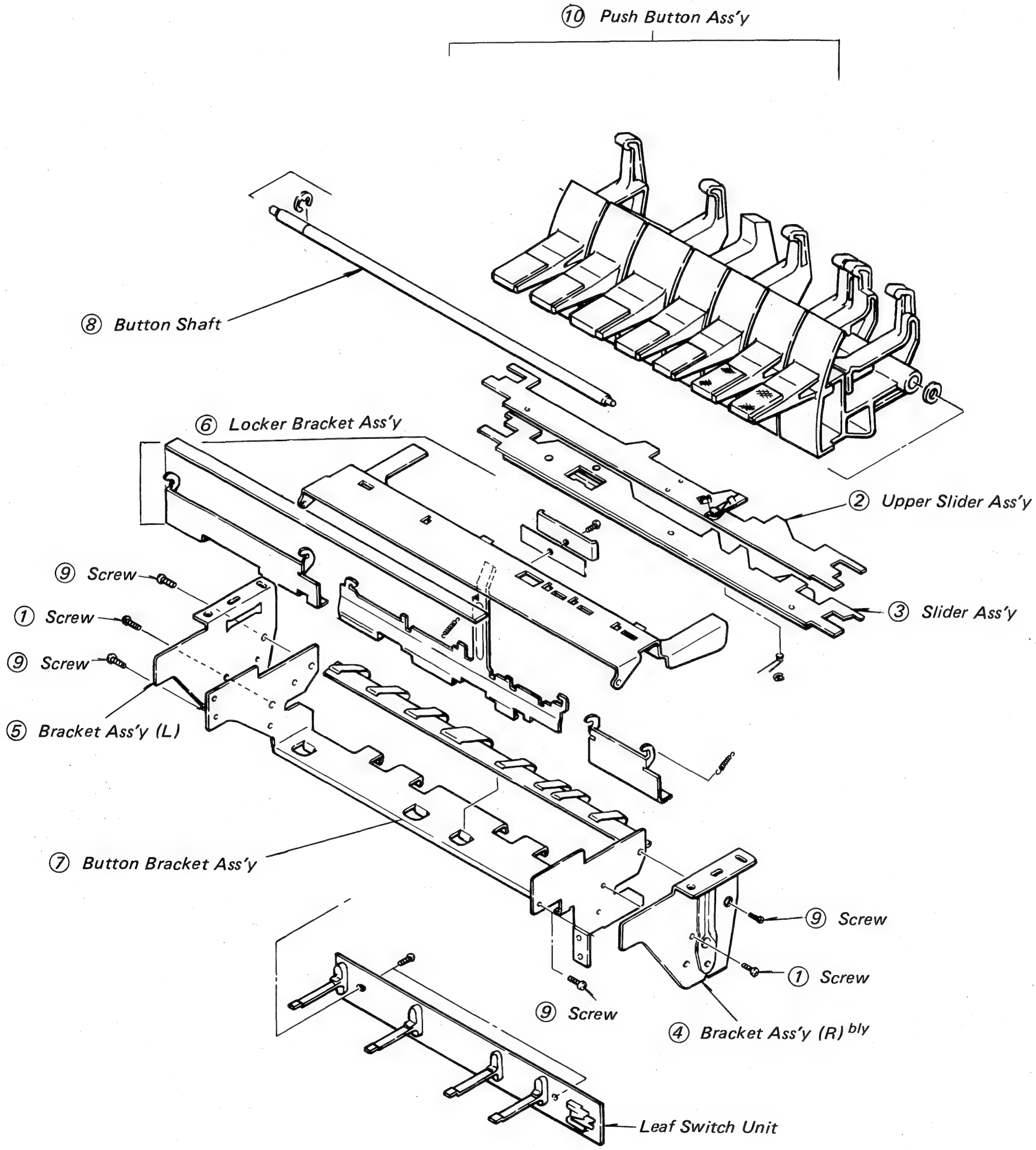


Fig. 5-51 Push Button Block Assembly

5-2-29 Checking, Adjusting, and Replacing the Slack Sensor Assembly

If the slack sensor assembly is in wrong position, it cannot detect tape slack in the playback and rec modes, and the tape could be tangled on the capstan or pinch roller. To prevent such a failure, check and adjust the slack sensor assembly as follows.

Checking

1. Leaving the FUNCTION switch in the OFF position, lock the cassette compartment without the cassette.
2. Depress the PLAY button.
3. Depress the cassette detect lever.
4. Turn the loading ring by hand to insure that the clearance between the pinch roller and slack lever tip is 2 to 4 mm.

Adjustment I (see Fig. 5-52)

1. Loosen the screw ⑦ holding the slack lever bracket ③.
2. Adjust the position of the slack lever bracket ③ until the clearance is 2 to 4 mm.
3. Tighten the screw.
4. Put the cassette into the cassette compartment.
5. Turn the FUNCTION switch to the ON position to load the tape.
6. Depress the PLAY button to run the tape.
7. Press the tape on the return guide pole ⑧ with your finger to slacken the tape and make certain that when the clearance between the top of the slack lever ② and cylinder base outlet assembly ④ is 1.5 to 3 mm, the tape stops.

Adjustment II

1. Loosen the screw ⑥ holding the slack switch unit ⑤.
2. Adjust the position of the slack switch unit ⑤ and proceed with Steps 4 through 7 in the "Adjustment I" procedures above.

Replacement

1. Remove the screw holding the slack switch unit ⑤.
2. Unsolder the wires on the slack switch unit ⑤ using a soldering iron.
3. Replace the slack switch unit ⑤.
4. Adjust the position of the slack switch ⑤ and proceed with Steps 4 through 7 in the "Adjustment I" procedures.

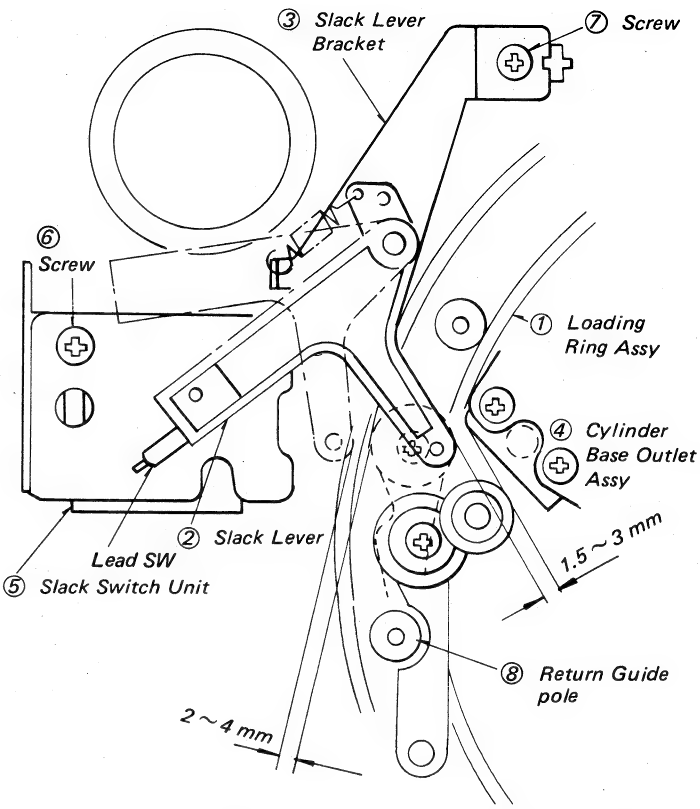


Fig. 5-52 Slack Sensor and Slack Switch Checking and Adjustment.

5-2-30 Adjusting and Replacing the EE Switch (see Fig. 5-53)

Improper adjustment of the EE switch cannot assure good picture in the playback or recording mode. To prevent such a failure, adjust the EE switch as follows.

Adjustment

1. Set the VTR in the stop mode.
2. Loosen the screw ④ holding the EE switch bracket ②.
3. Adjust the EE switch bracket ② until the EE switch ① is at 0.5 mm far away from the position where the EE switch ① is turned on by the EE switch slider ③.
4. Make certain that the EE switch ① is turned off when the PLAY button is depressed and it cannot be turned on even when the REC button is depressed over the audio dubbing mode.

Replacement

1. Unsolder the lead wires on the EE switch ① for disconnection using a soldering iron.
2. Remove the screw holding the EE switch ①.
3. Replace the EE switch ①.
4. Adjust the EE switch bracket ②. Refer to Steps 3 and 4 in the "Adjustment" procedures above.

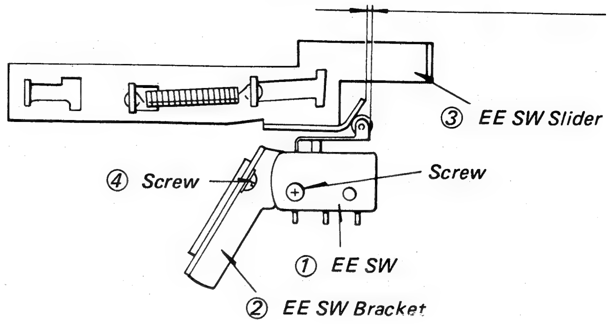


Fig. 5-53 EE Switch Adjustment and Replacement.

5-2-31 Positioning the Pause Solenoid and Pause Brake Lever and Replacing the Pause Solenoid

If the pause solenoid or pause brake lever is not aligned in position, the tape cannot be started or stopped normally when the PAUSE switch is pressed. To prevent such a failure, adjust them as follows.

Positioning the pause solenoid (see Fig. 5-54)

1. Set up the cassette to load the tape.
2. Turn the FUNCTION switch to the OFF position.
3. Depress the PLAY button.
4. Loosen the two screws holding the pause solenoid ①.
5. Adjust the pause solenoid ① until the clearnace between the capstan ⑥ and pinch roller ⑤ is 0.3 to 0.7 mm when the core of the pause solenoid ① is pulled out to the end.

Positioning the pause brake lever (see Figs. 5-54, -55)

1. After adjusting the pause solenoid in position as directed above.

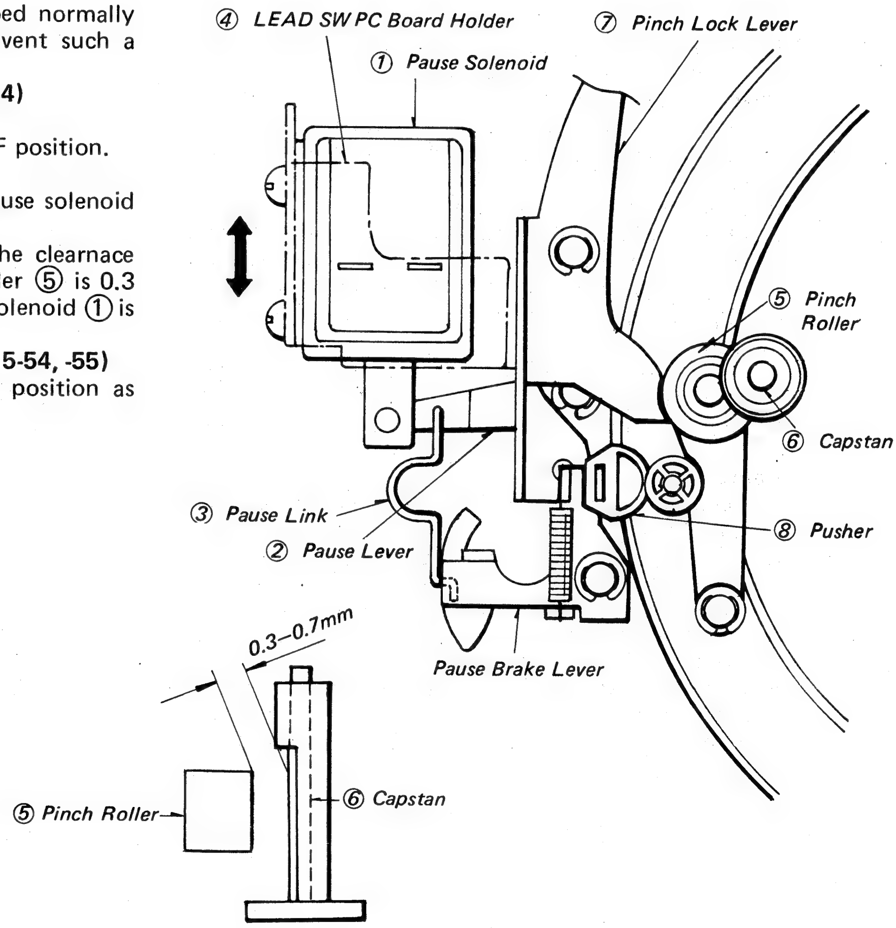


Fig. 5-54 Pause Solenoid Positioning and Replacement.

2. Then, adjust, or bend, the pause ring on the convex portion so that the clearance between the pusher ⑧ and return guide roller ⑨ is 0.2~0.8 mm.

Replacing the pause solenoid

1. Remove the two screws holding the pause solenoid ① and lead switch PC board holder ④.
2. Remove the pause solenoid ① and lead switch PC board holder ④.
3. Unsolder the wires on the pause solenoid ① using a soldering iron.
4. Take the pause lever ② out of the core of the pause solenoid ①.
5. Replace the pause solenoid by reversing Steps 1 through 4.
6. Adjust the pause solenoid in position as directed in the "Positioning the pause solenoid" procedures above.

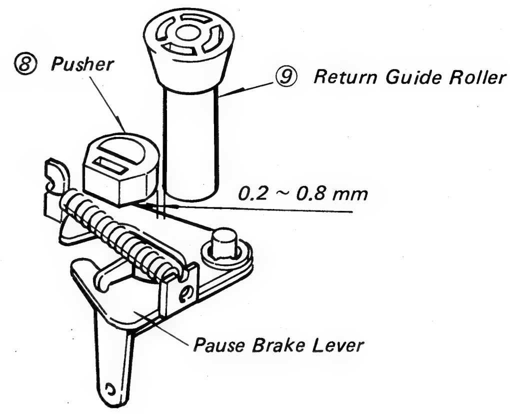


Fig. 5-55 Pause Brake Lever Adjustment.

5-2-32 Checking, Adjusting, and Replacing the Pinch Roller Lever (see Fig. 5-56)

Checking and adjustment

1. Check the pinch roller for dirt, scratches, wear, and vertical play. Do not be concerned about horizontal play.
2. Check the screw ② for looseness.
3. Check to insure that the pinch roller can be turned freely by band. The pinch roller should turn without any seizure when turned lightly by finger tips.
4. Adjust the pinch roller lever ③ for moderate vertical looseness.
5. Adjust the pinch roller lever spring ④ for effective pressure.
6. Wipe dirt off the pinch roller or replace it if defective.

Replacement

1. Remove the screw ② holding the pinch roller assembly ①.
2. Lift the pinch roller upward for removal.
3. Assemble the pinch roller by reversing Steps 1 and 2.
4. Wipe to clean the surface of the pinch roller.
5. Run the tape to insure that it is free from curl or wrinkles.
6. If any, proceed with tape path adjustment as will be described in Section 5-2-48, the "Adjusting the Tape Path".

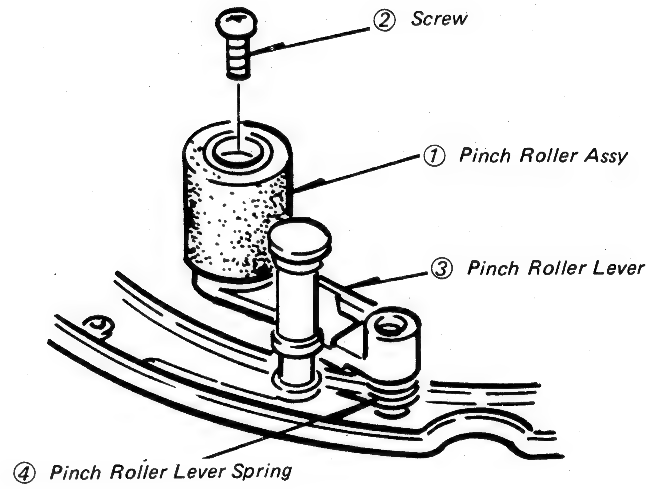


Fig. 5-56 Pinch Roller Assembly Replacement.

5-2-33 Checking and Adjusting the Arrangement Associated with Loading Drive Assembly

The arrangement associated with the loading drive assembly, if not adjusted well, causes unusual tension on the tape or prevents tape loading or unloading. In such an event, proceed as follows:

Checking with removal of top cover

1. Remove the top cover as directed in Section 5-1-2, the "How To Remove the Cabinet".
2. Make certain that loading takes not longer than 3 sec and unloading is not longer than 5 sec.
3. Also, make certain that the clearance between the loading ring and loading ring roller is 0.15 mm (standard). In the standard clearance, the loading disk clearance gauge should be tightly inserted into the clearance when the loading ring is in the unloading state (see Fig. 5-57).

NOTE: Too close clearance will not allow normal loading and unloading. Too wide clearance, on the other hand, will casue loose movement of the loading ring, resulting in bad performance.

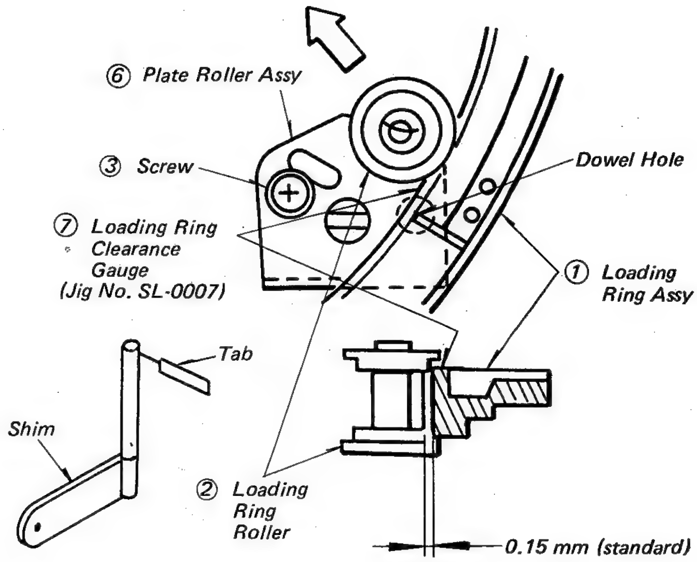


Fig. 5-57 Plate Roller Assembly.

Visual checking with removal of bottom cover and video circuit board PW-2109

1. Remove the bottom cover as directed in Section 5-1-2, the "How To Remove the Cabinet".
2. Remove the Video Circuit board PW-2109.
3. Make certain that the gear on the loading drive assembly is engaged properly with the gear on the loading ring. Note that too close engagement will not allow smooth movement of the loading ring.

Adjustment

1. If the clearance between the loading ring and loading disk roller is out of the tolerance (0.15 mm), proceed as follows: (also, see Fig. 5-57).
   a. Loosen the screw ③ holding the plate roller assembly ⑥.
   b. Insert the loading ring clearance gauge ⑦ into the gap between the loading ring ①and loading ring roller ②.
   c. Firmly tighten the screw.
   d. Remove the loading ring clearance gauge ⑦.
2. If the gear on the loading drive assembly is not engauged properly with the gear on the loading ring, proceed as follows:
   a. Loosen the two screws ③ holding the loading drive assembly ① for temporarily securing (see Fig. 5-59).
   b. Insert the DC motor gear spacer ⑧ into the gap between the gear ⑨ and gear on the loading ring assembly ① (see Fig. 5-58).
   c. Adjust the DC motor gear spacer ⑧ so that the gap between the gear ⑨ and gear on the loading ring assembly ① is zero (see Fig. 5-58).
   d. Firmly tighten the screws.
   e. Remove the DC Motor Gear Spacer ⑧.
3. If loading or unloading cannot be performed well even for good adjustments achieved in Steps 1 and 2 above, then replace the loading drive assembly in the way that will be described in Section 5-2-34 below.

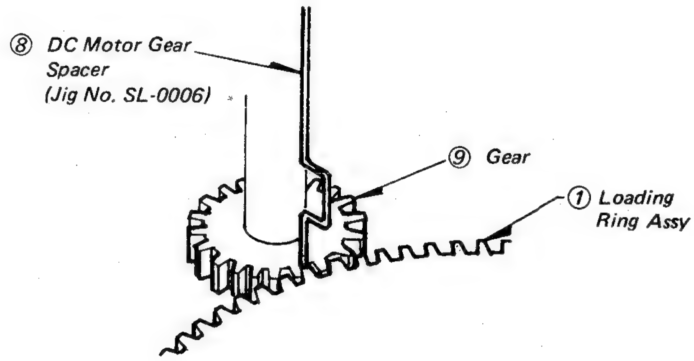


Fig. 5-58 Gear Engagement.

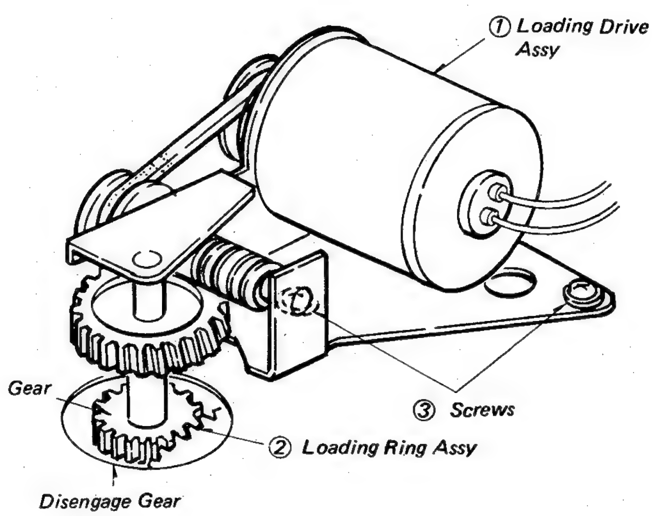


Fig.5-59 Loading Drive Assembly.

5-2-34 Replacing the Loading Drive Assembly (see Figs. 5-58, -59)

1. Remove the bottom cover as directed in Section 5-1-2, "How To Remove the Cabinet".
2. Remove the Video Circuit board PW-2109.
3. Remove the two screws holding the loading drive assembly ① (see Fig. 5-59).
4. Unsolder the wires on the loading drive assembly ① using a soldering iron.
5. Replace the loading drive assembly and solder the wires.
6. Lightly tighten the screws to temporarily secure the loading drive assembly.
7. Insert the DC motor gear spacer ⑧ into the gap between the gear ⑨ and gear on the loading ring assembly ② (see Fig. 5-58).
8. Adjust the DC motor gear spacer ⑧ so that the gap is zero.
9. Firmly tighten the screws.
10. Remove the DC motor gear spacer ⑧.
11. Measure the loading and unloading times to insure that they are within 3 and 5 sec, respectively.
12. Assemble Video Circuit board PW-2109 and the bottom cover.

5-2-35 Replacing the Loading Ring Assembly

1. Remove the top cover and bottom cover as directed in Section 5-1-2, the "How To Remove the Cabinet".
2. Remove the Video Circuit board PW-2109.
3. Loosen the two screws holding the loading drive assembly ①. (see Fig. 5-58)
4. Separate the gear from the loading ring assembly ② (see Fig. 5-59).
5. Turn the loading ring ② until the point Ⓐ on the loading ring fits together with the point Ⓑ on the pinch lock lever ④ (see Fig. 5-60).
6. Loosen the screw holding the Plate Roller assembly (see Fig. 5-57).
7. Take the plate roller assembly out of the dowel hole and move it in the arrow (⇖) direction.
8. Unsolder the wires on the pause board PW-2113 (see Fig. 5-61).
9. Unplug the 3P connector ⑫, 11P connector ⑬ and 13P connector ⑭ from the pause board PW-2113 (see Fig. 5-61).
10. Loosen the screw ⑩ and remove the Pause board PW-2113 (see Fig. 5-61).
11. Remove the two screws holding the bracket ⑨.
12. Replace the loading ring assembly ② in the position shown in Fig. 5-60.
13. Check to insure that the loading ring is held properly by the three loading ring rollers.
14. Lightly slide the plate roller assembly ⑥ in opposite the direction of the arrow (see Fig. 5-57) and temporarily tighten the screw.
15. Insert the loading ring clearance gauge ⑦ of 0.15 mm thick into the clearance between the loading ring assembly ① and plate roller assembly ⑥, press this in the arrow (⇖) direction, and firmly tighten the screw (see Fig. 5-57).
16. Remove the loading ring clearance gauge ⑦.
17. Assemble the pause board PW-2113 by reversing steps 8 and 9.
18. Insert the D.C motor gear spacer ⑧ into the gap between the gear on the loading ring assembly ② (see Fig. 5-58).
19. Adjust the D.C motor gear spacer ⑧ so that the gap may be zero.
20. Firmly tighten the two screws to hold the loading drive assembly.
21. Turn the loading ring ② to the end of loading and check to insure that the loading ring ② is locked by the roller on the cam follower lever ⑤ and the two loading end switches ⑧ are actuated to turn on (see Fig. 5-62).
22. Measure the loading and unloading times to insure that they are within 3 and 5 sec, respectively.
23. Play the service-use alignment tape to insure that the picture is reproduced normally.
24. If the picture is not good, then proceed with tape path adjustment (refer to Section 5-2-48 the "Tape Path Adjustment".

CAUTION:-In removing or installing the Bracket ⑨ (see Fig. 5-61), care should be taken not to damage the wires.

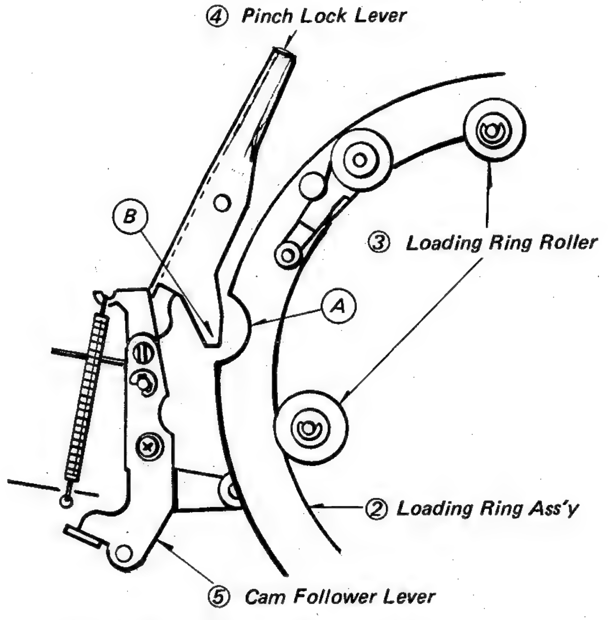


Fig. 5-60 Loading Ring Removal.

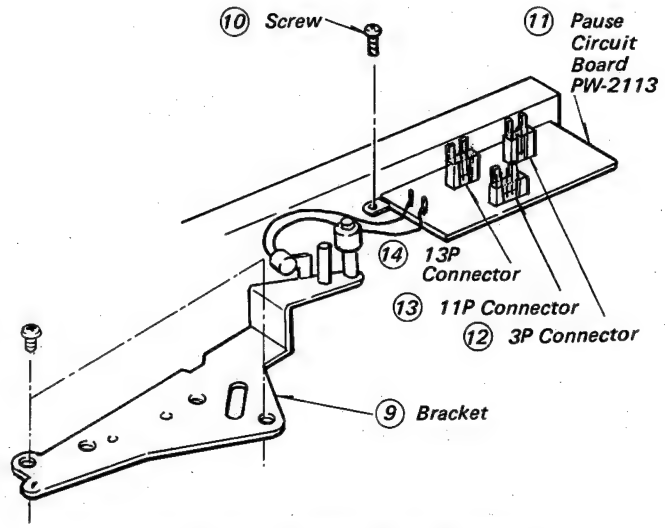


Fig. 5-61 Loading Ring Removal.

5-2-36 Positioning and Replacing the Loading End Switch (see Fig. 5-62)

The loading end switch, if not adjusted properly, will not allow the tape to run even when the PLAY or REC button is depressed or will not stop the motor for the loading drive assembly. To assure the function of the loading end switch, proceed as follows:

Positioning

1. Set the cassette in the loading end state.
2. Adjust the loading switch bracket ⑨ to 0.5 mm away from the position where the loading end switch ⑧ is turned on by the cam follower lever ⑤.

Replacement

1. Remove the screw ⑤ holding the loading switch bracket ④.
2. Unsolder the wires on the loading end switch ③ using a soldering iron.
3. Remove the two screws ⑥ holding the loading end switch ③.
4. Replace the loading end switch by reversing Steps 1 through 3.
5. Adjust the loading end switch in position as directed in the "Positioning" procedures above.
6. Check to insure that the loading end switch functions normally.

5-2-37 Checking the Belts

A dirty, scratched, or worn belt greatly affects the sound and picture quality. To prevent such deterioration, check the belts and replace the defective one if necessary. (For replacement, follow Section 5-2-39, the "Replacing the Belts and Pulleys".)

Checking

1. Make certain that each drive belt is free from dirt, scratches, wear, and elongation.
2. For a dirty belt, wipe in with cloth moistened in isopropyl alcohol. For scratched, worn, or elongated belt, replace it according to Section 5-2-39.

5-2-38 Replacing the Capstan Motor (see Fig. 5-61, 5-63)

1. Remove the top cover and bottom cover as directed in Section 5-1-2, the "How to Remove the Cabinet."
2. Remove the Video Circuit board PW-2109.
3. Remove the guide pulley flat belt ①.
4. Remove the capstan flat belt ② from the motor pulley ④.
5. Loosen the two set screws ⑩ holding the motor pulley.
6. Remove the motor pulley from the motor ⑤.
7. Unplug the connectors ⑬ (for power source and FG output) from the Servo and Logic Circuit Board PW-2110.
8. Unsolder the wires on the pause board PW-2113 ⑪ (see Fig. 5-61).
9. Unplug the 3P connector ⑫ , 11P connector ⑬ and 13P connector ⑭ from the pause board PW-2113 ⑪ .
10. Loosen the screw ⑩ and remove the Pause board PW-2113.
11. Remove the three screws ⑫ holding the motor ⑤ on the motor holder bracket ⑭ .

NOTE: Turn the VTR set sideway, when side panel (L) is below.

12. Replace the motor by reversing steps 1 through 11.

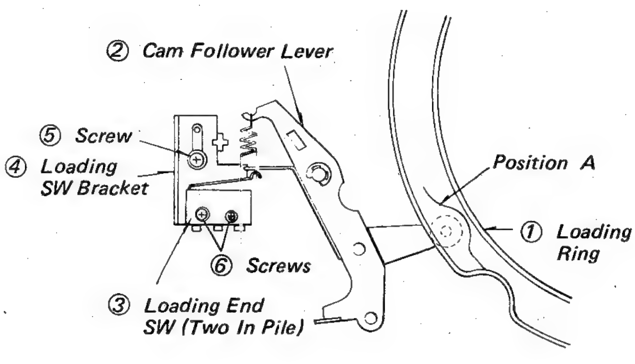


Fig. 5-62 Loading End Switch Positioning and Replacement.

5-2-39 Replacing the Belts and Pulleys (see Fig. 5-63)

Removal

1. Remove the bottom cover as directed in Section 5-1-2, the "Removing the Cabinet".
2. Remove the Video Circuit board PW-2109.
3. Remove the guide pulley flat belt ① with leaving the motor pulley ④ and guide pulley ⑧ installed.
4. Take the fast-forward and rewinding square belts ③ off the guide pulley ⑧.
5. Loosen the screws ⑮ .
6. Pull the thrust bearing ⑦ in the arrow (☞) direction for removal.
7. Remove the capstan flat belt ② .
8. Loosen the two set screws ⑩ holding the capstan motor pulley ④.
9. Lift the capstan motor pulley ④ straight up for removal.

Installation

1. Wipe the capstan flat belt ② with cloth dampened in isopropyl alcohol.
2. Put the capstan flat belt ② on the capstan flywheel ⑥ , with the belt mark in the revolutional direction.
3. Place the thrust bearing ⑦ .
4. Tighten the two screws ⑮ .
5. Hold the capstan motor pulley ④ in position where its flange is $22.5 \pm {}^{0.3}_{0}$ mm above the top of the motor holder bracket ⑭ , and tighten the two set screws ⑩ .
6. Check to insure that the mark on the capstan flat belt ② is in the revolutional direction, and put it on the capstan motor pulley ④.
7. In turn, wipe the fast-forward and rewind square belt ③ with a cloth dampened in isopropyl alcohol.
8. Place the fast-forward and rewind square belt ③ on the guide pulley ⑧ , with its white mark opposite to the pulley surface. The belt should not be kinked.
9. Also, wipe the guide pulley flat belt ① with a cloth dampened in isopropyl alcohol.
10. Put the guide pulley flat belt ① on the capstan motor pulley ④ and guide pulley ⑧ , with the belt mark in the revolutional direction.
11. After replacing the belts, check to insure that the belt marks coincide with their respective revolutional directions.
12. Install the Video Circuit board PW-2109.

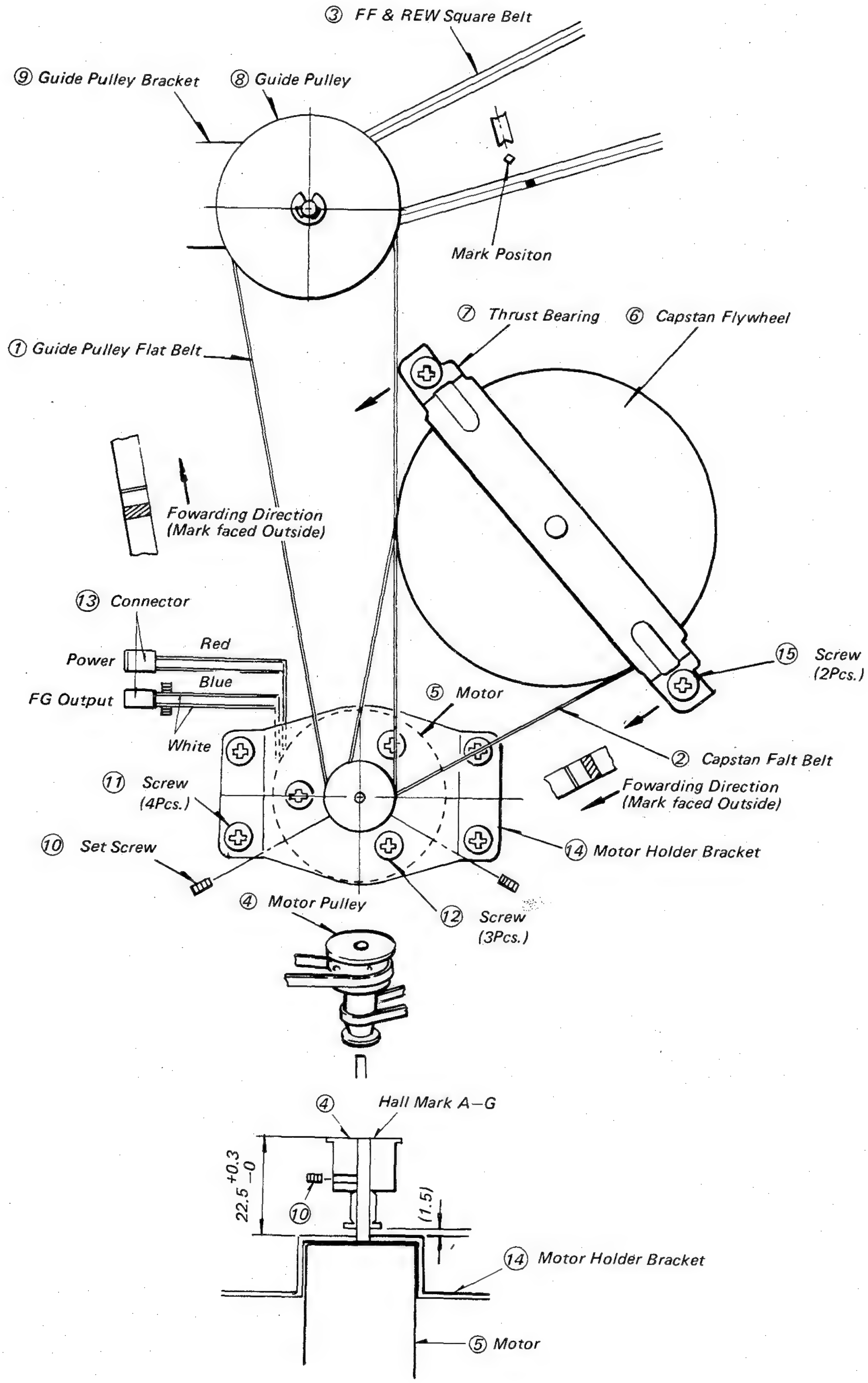


Fig. 5-63 Motor Belt and Pulley Replacement.

5-2-40 Checking the Tape Speed

If a VTR cannot run tape at the rated speed, it is not interchangeable with another VTR, or the tape recorded by one VTR cannot be played back by another VTR, and vice versa. Whenever the capstan flat belt or motor pulley is replaced, check the tape speed as follows.

Checking

1. Connect a frequency counter to the AUDIO LINE OUT terminal on the rear panel.
2. Connect TP513 on the Servo and Logic Circuit board PW-2110 with on TP516 (5V line).
3. Play back the 3 kHz part on a test tape to insure that the frequency counter reads 3 kHz ± 6 Hz.

Adjustment

1. Remove the wrong existing capstan pulley.
2. Select a proper capstan motor pulley from the table below and replace it.

ITEM	PART CODE	MARK	DIA	TAPE SPEED
Capstan Motor Pulley	70341249	G	Large	High
	70341248	F	↑	↑
	70341247	E		
	70341246	D		
	70341245	C		
	70341244	B	↓	↓
	70341243	A	Small	Slow

5-2-41 Checking and Replacing the Tape Retainer Assembly (see Fig. 5-64)

If the tape retainer spring is deformed or its pressure is too low, replace the tape retainer spring assembly as follows.

1. Remove the screw ① holding the tape retainer spring assembly ②.
2. Replace the assembly with this pressed fully to the end in the arrow (⇖) direction as shown.
3. Play back a alignment test tape to insure that the monochrome signal is normally reproduced on the TV set.

Checking after replacement

1. Play back the monochrome signal of the alignment test tape and observe the envelope waveform shown on an oscilloscope.
2. If the envelope waveform is not acceptable, proceed with tape path adjustment as will be described in Section 3-2-48, the "Adjusting the Tape Path".

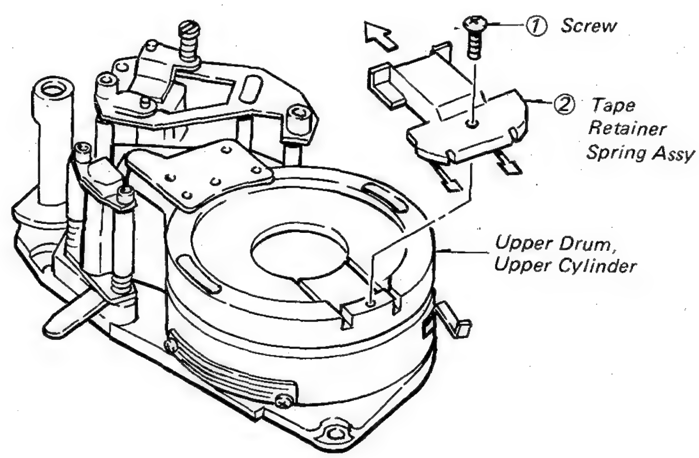


Fig. 5-64 Tape Retainer Spring Assembly Replacement.

5-2-42 Checking and Replacing the Upper Cylinder (see Fig. 5-65)

If the upper cylinder is scratched or worn, replace it as follows.

Replacement

1. Remove the screw ① holding the tape retainer spring assembly ②.
2. Remove the three screws ③ and three screws ⑥ holding the upper cylinder ⑤.
3. Replace the upper cylinder. Be careful not to loose the spacer, if any is present.
4. Place the bracket ④ , together with the upper cylinder in combination, in position on the connector ⑦.
5. Temporarily tighten the three screws ③.
6. Press the upper cylinder in position on the connector ⑦ and fully tighten the screws ③.
7. Place the tape retainer spring assembly ② in position and tighten the screws ① to hold it (refer to Section 5-2-41 above).

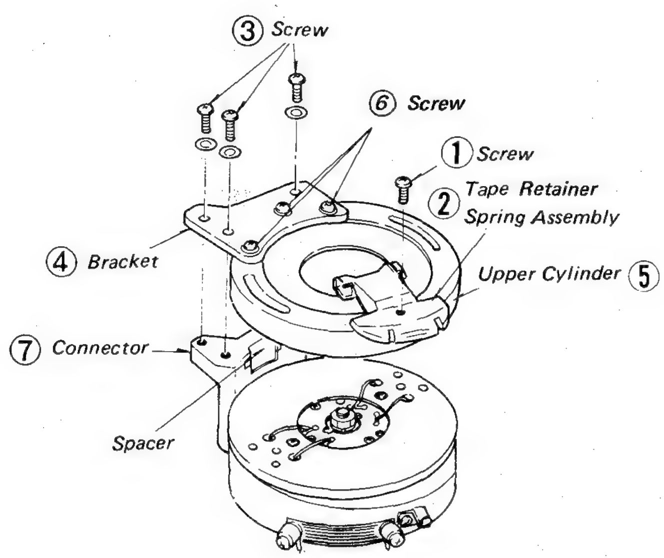


Fig. 5-65 Upper Cylinder Replacement.

5-2-43 Checking, Adjusting, and Replacing the Video Head Disk Assembly

Checking

1. Check each video head for damage, wear or clogging.
2. If the video head cannot be refurbished, particularly by wiping it with cleaning kit, replace the video head disk assembly as will be directed below.

Replacement (see Fig. 5-66)

1. Remove the three screws ① holding the bracket ② combined with the upper cylinder.
2. Take out the bracket ② together with the upper cylinder.
3. Unsolder the four video head wires from the intermediate board ③.
4. Remove the two screws ④ holding the video head disk assembly ⑤.
5. Take out the video head disk assembly ⑤, leaving the spacers if any on the flange ⑥.
6. Wipe the bottom of the new video head disk assembly and the top of the flange ⑥ with a cloth dampened in isopropyl alcohol; also, wipe the top of the spacers if any.
7. Position the video head disk assembly ⑤ with its red wire at the circle mark (O).
8. Lightly tighten the screw ④ to temporarily hold the video head disk assembly ⑤ with two fingers handling a screwdriver. (The screws should be so tightened to allow eccentricity adjustment.)

Precaution: -When removing or installing the video head disk assembly, never touch the video heads on the connector ⑦ (see Fig. 5-66).
Full care should be observed not to touch any video head disk by hand as it could be damaged.

Eccentricity adjustment

1. Remove the screw ① holding the capacitor ② (see Fig. 5-67).
2. Take out the capacitor ② together with the bracket, leaving the wires connected to it.
3. Mount the plate ④ on the frame (R) with screw ①.
4. Mount a cylinder eccentricity gauge ③ in position on the plate with the wing screw A ② (see Fig. 5-68).
5. Position the probe of the dial gauge around 2 mm below the top of the video head disk assembly ⑤ (see Fig. 5-68 and 5-69).

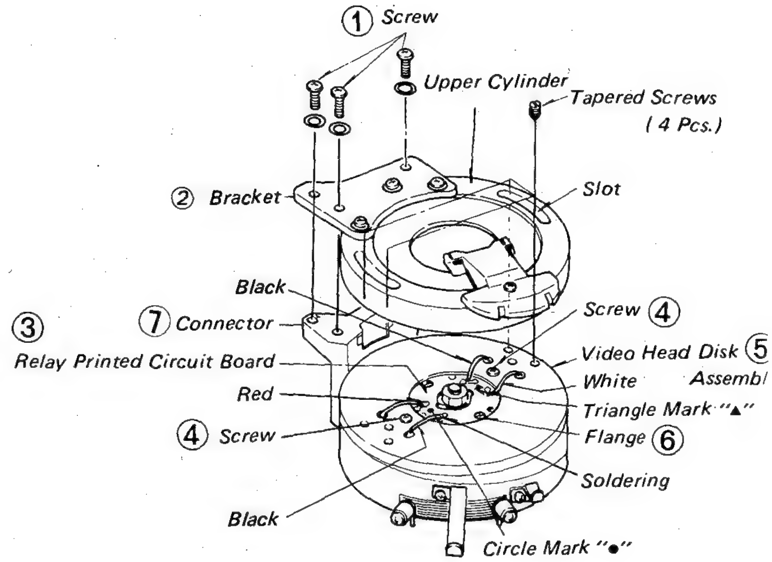


Fig. 5-66 Video Head Disk Assembly Replacement.

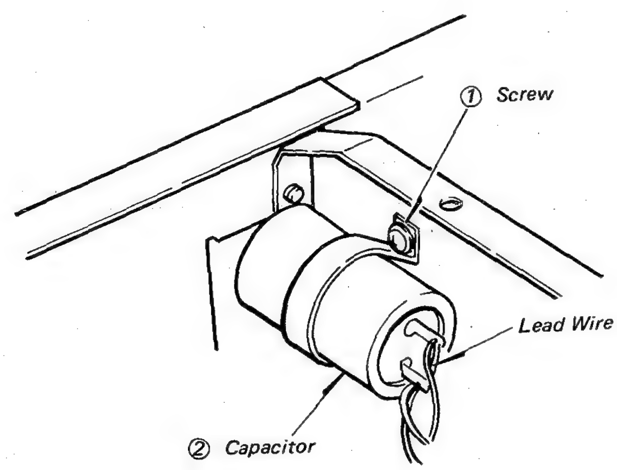


Fig. 5-67 Cylinder Eccentricity Gauge Installation (1).

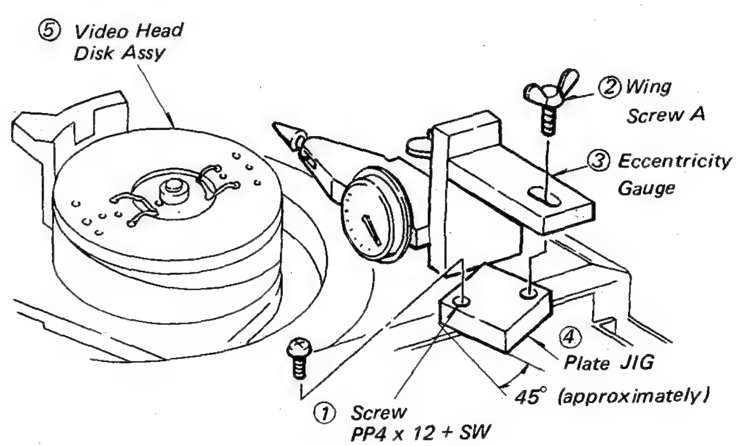


Fig. 5-68 Cylinder Eccentricity Gauge Installation (2).

Adjustment

1. Loosen the wing screw A and adjust the dial gauge ② so that the needle is at the center of the scale (see Fig. 5-68).
2. Tighten the wing screw A.
3. While gently turning the video head disk assembly ⑤ counterclockwise by hand, read the dial gauge ②.
4. When the dial gauge ② indicates that the video head disk assembly ⑤ is most eccentric to the dial gauge ② side, stop turning the video head disk assembly ⑤ (see Fig. 5-69).
5. Fit a bladed screwdriver on the inside surface of the video head disk assembly ⑤ and lightly tap it until the needle returns a half of the maximum deflection measured in Steps 1 through 4 above.
6. Repeat the adjustement in Step 5 above several times until the needle deflects as little as possible when the video head disk assembly is rotated. (minimum eccentricity.)

NOTE:-The standard eccentricity is within 1 μ.

7. After adjustment, tighten the two screws ③ little by little alternately. Torque each screw to more than 10 kg.cm.
8. Check the cylinder eccentricity again.
9. Solder the video head wires to the intermediate PW board.

CAUTION:-Fit the wires close to the video head disk assembly so as not to allow them to touch the upper cylinder.

10. Tighten the screw ① (in Fig. 5-67) to hold the capacitor ② together with the bracket.
11. Assemble the upper cylinder in accordance with Section 5-2-42, the "Checking and Replacing the Upper Cylinder".

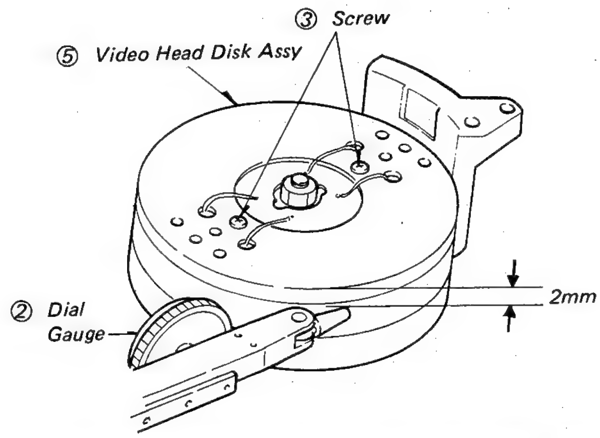


Fig. 5-69 Measurement of the Video Head Disk Assembly Eccentricity

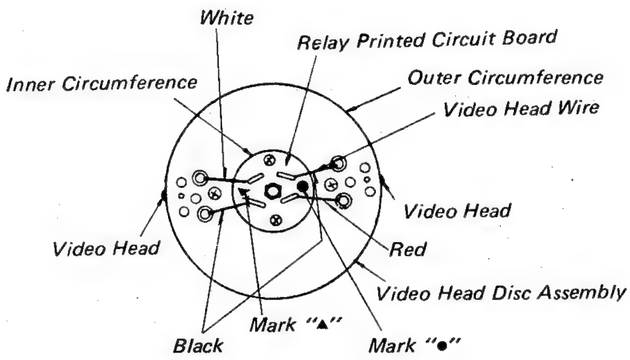


Fig. 5-70 Video Head Wires.

5-2-44 Replacing the Cylinder Assembly and Cylinder Motor Rotor and Stator

1. Remove the Tuner Block as directed in Section 5-1-3, the "Replacing the Tuner Block".
2. Disconnect the 10-pin connector P101, 4-pin connector P701, and 5-pin connector P704 from the Audio Circuit board PW-2108 and press the connectors inside the right corner of the frame (see Fig. 5-71).
3. Disconnect the 3-pin connector P501, 4-pin connector P502, and 3-pin connector P601 from the Servo and Logic Circuit board PW-2110 (see Fig. 5-72).
4. Disconnect the 3-pin connector P902 from the Pause Board PW-2113 (see Fig. 5-61).
5. Remove the Video Circuit board PW-2109.
6. Remove the two screws ⑤ in Fig. 5-73.
7. Disconnect the 3-pin connector P961 from the Disk Drive Circuit board PW-2115.
8. Loosen the two screws ① and take out the thrust bearing ② (see Fig. 5-73).
9. Remove the capstan flat belt ③ and take off the capstan flywheel ④ (see Fig. 5-73).
10. Take the unplugged connectors off the lead clamp and keep them under the cylinder unit.
11. In turn, remove the three screws ① and ② and take out the cylinder assembly. (see Fig. 5-76.)

NOTE:-To install the cylinder assembly, proceed as follows:

a. Lightly tighten the screws ① and ② in Fig. 5-74.
b. Pressing the cylinder assembly in a clockwise direction, tighten the three screws ① and ②.
c. Put the audio head wires (yellow) in position away from the cylinder assembly (see Fig. 5-75).

12. In turn, replace the cylinder assembly and disk motor rotor and stator as follows. Also, refer to Figs. 5-76, -77, and -78.

a. Remove the screws ① and ② and take out the cylinder assembly ③ (see Fig. 5-76).

NOTE:-To install the cylinder assembly ③ on the cylinder base ④ proceed as follows: (see Fig. 5-76, 77, 78)

i. Lightly tighten the screws ① and ② in Fig. 5-76.
ii. Press the cylinder base ④ toward the clockwise direction and tighten the screws ① and ②.

b. Loosen the nut ⑬, remove it.
c. Remove the spring washer ⑫.
d. Remove the washer ⑪.
e. Remove the Rotor ⑩.
f. Disconnect 3-pin connector ④ from the stator ⑧.
g. Loosen two screws ⑨ and remove the stator ⑧.

NOTE:-When installing the stator, proceed as the 3-pin plug comes to the connector side of cylinder.

h. Remove the two screws ⑥.
i. Remove the motor shielding case ⑦ and the shielding case ⑤.

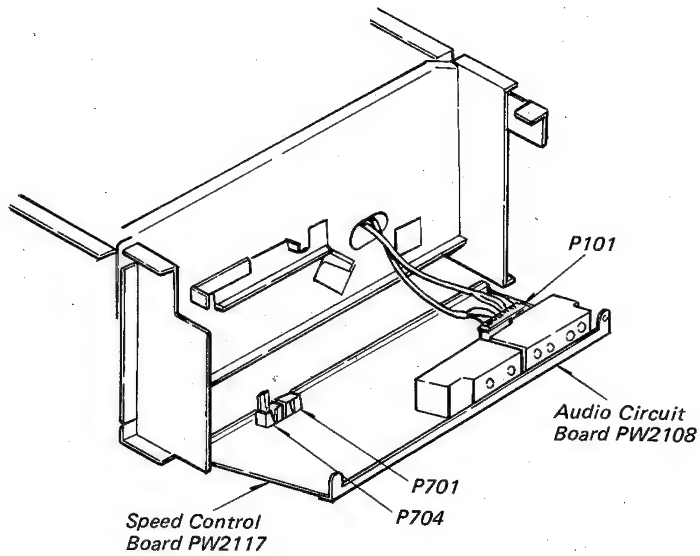


Fig. 5-71 Audio Circuit Board PW-2108.

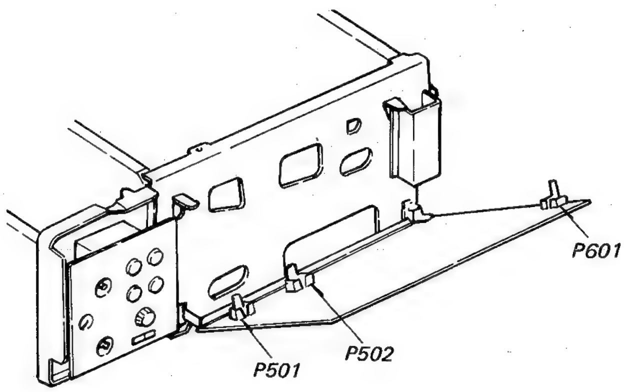


Fig. 5-72 Servo and Logic Circuit Board PW-2110.

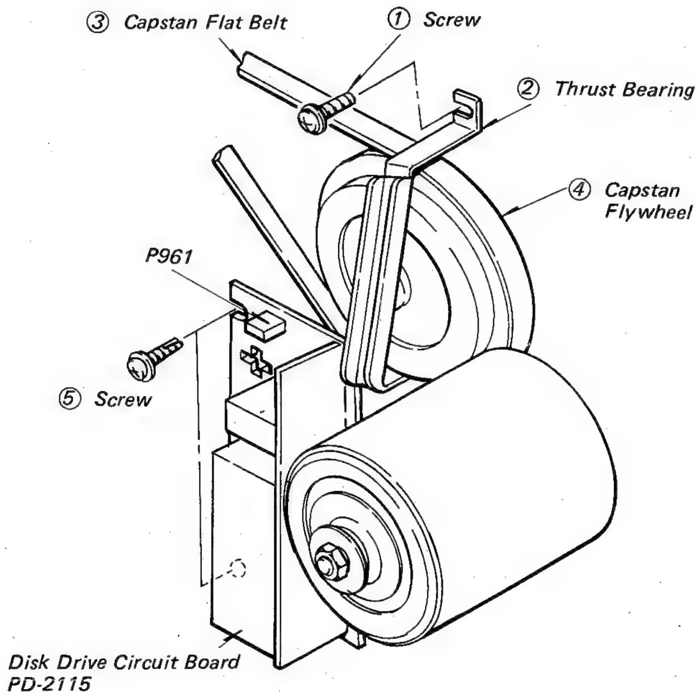


Fig. 5-73 Disk Drive Board PW-2115 and Capstan Flywheel.

NOTE:-To assemble the cylinder assembly, reverse Steps 1 through 12.

13. Perform tape path adjustment as will be described in Section 5-2-48, the "Adjusting the Tape Path". Also, carry out the electrical adjustment.

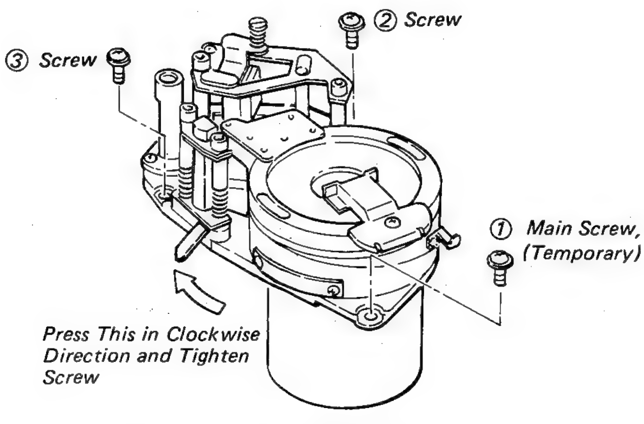


Fig. 5-74 Cylinder Assembly Removal.

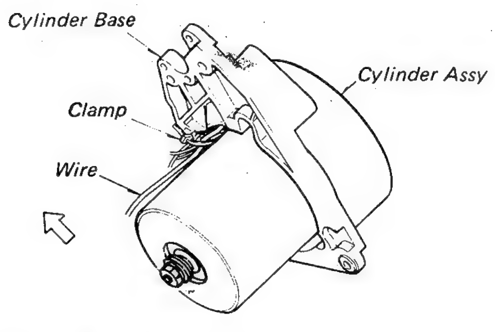


Fig. 5-75 Lead Wire Slackening.

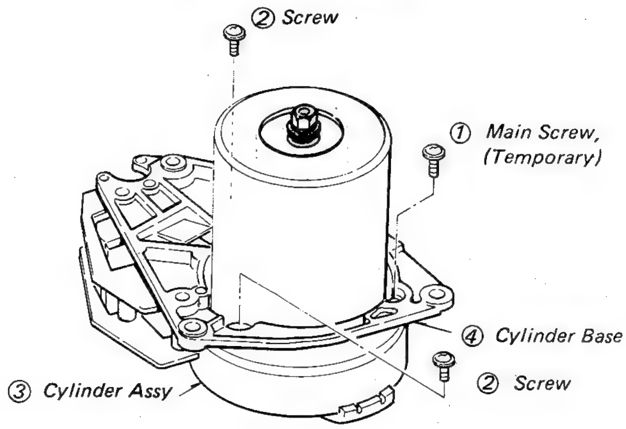


Fig. 5-76 Cylinder Base Removal and Installation.

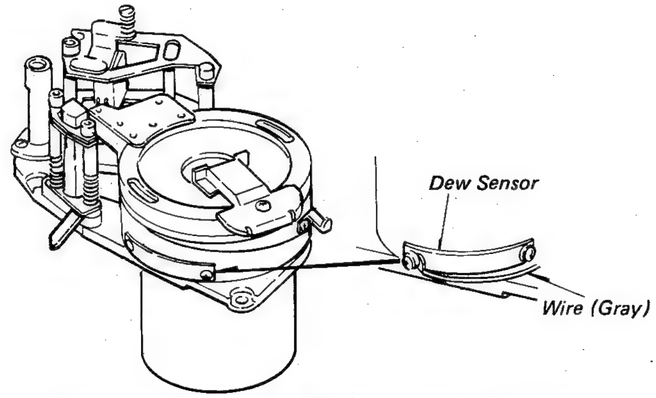


Fig. 5-77 Cylinder Assembly Shown in Relation with Dew Sensor

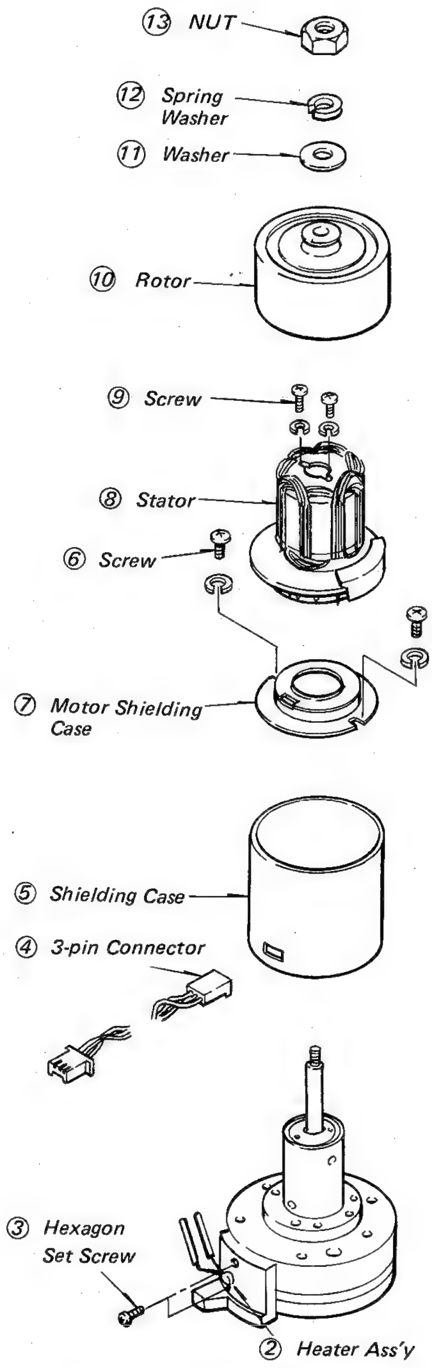


Fig. 5-78 Disk Motor Replacement.

5-2-45 Replacing the Audio and Control Head Assembly (see Fig. 5-79, -80)

1. Unclamp the wires and slacken them from the rear side of the main chassis.
2. Remove the two nuts ①.
3. Lifting the audio control head assembly ② upward, unsolder the wires.
4. Assemble the audio and control head assembly by reversing Steps 1 through 3.
5. Clamp the wires, with the yellow audio head wires placed in position far away from the cylinder assembly.
6. Perform tape path adjustment as will be described in Section 5-2-48, the "Adjusting the Tape Path".

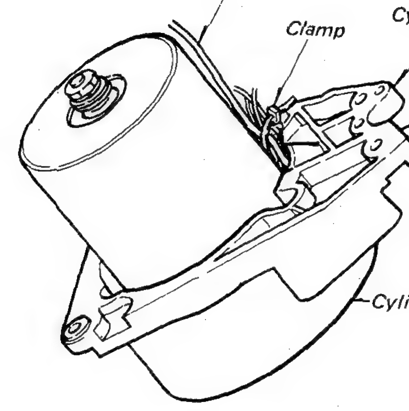


Fig. 5-79 Wire Slackening.

5-2-46 Replacing the Fully Width Erase Head (see Figs. 5-81)

1. Unclamp the wires and slacken them from the rear side of the main chassis.
2. Remove the nuts ① and ② holding the full width erase head ⑩.
3. Take out the mounting hardware, including the inlet guide plate (upper) ③ through the spring ⑨, in sequence shown in Fig. 5-81.
4. Lifting the full width erase head ⑩ upward, unsolder the wires.
5. Assemble the full width erase head ⑩ by reversing Steps 1 through 4.
6. Clamp the wires, with yellow audio head wires placed in position far away from the cylinder assembly.
7. Perform tape path adjustment as will be described in Section 5-2-48, the "Adjusting the Tape Path".

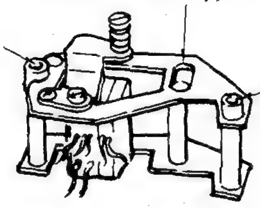


Fig. 5-80 Audio and Control Head Assembly.

5-2-47 Replacement the Heater Ass'y

1. Loosen the two hexagon set screws by the hexagon set driver for removal of the heater assembly.
2. Unsolder the wires of the Heater Assembly.
3. Assemble the heater assembly by reversing steps 1 through 2.

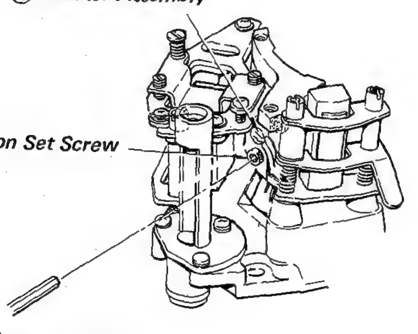


Fig. 5-82 Replacement the Heater Ass'y

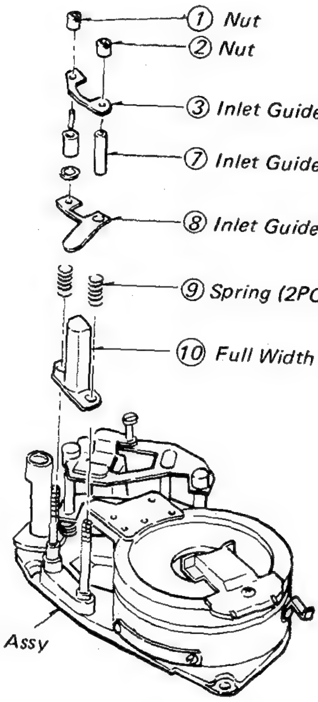


Fig. 5-81 Full Width Erase Head Replacement.

5-2-48 Adjusting the Tape Path

Whenever any of the services listed below has been carried out, checking must be performed in the audio line output level and envelope waveform and inner curling in the tape path guide system. Tape path adjustment, also, should be performed if necessary.

a. Reel deck assembly replacement.
b. Tension lever replacement.
c. Upper and lower cylinder removal and installation.
d. Video head disk assembly removal and installation.
e. Cylinder base removal and installation.
f. Audio and control head removal and installation.
g. Full width erase head removal and installation.
h. Loading ring removal and installation.
i. Pinch roller assembly replacement.

CAUTION:-Servicemen should be fully trained in the tape path adjustment as this requires highly-advanced technique and skill.

Preparation for tape path adjustment

The tape jigs, and instruments required for tape path adjustment are as follows.

1. Alignment test tape.
2. Dual Trace Oscilloscope.
3. VTVM.
4. Eccentric screwdriver (for CTL positioning).
5. Dental mirror (for tape run checking).
6. Tension regulator bending jig.

Adjust points (see Fig. 5-83)

1. Inlet tape guide nuts ① and ② .
2. Outlet tape guide nuts ③ and ④ .
3. Audio azimuth adjust screw, 1 piece.
4. CTL positioning screws, 3 pieces.

Adjusting procedures

The tape path should be adjusted in the sequence: (1) Rough adjustment, (2) Video and audio head tracking adjustment, (3) Audio azimuth adjustment, and (4) CTL positioning adjustment. Each adjusting procedures will be described below.

(1) Rough adjustment (see Figs. 5-83, -84, -85)

CAUTION:-In rough adjustment, alignment tape should not be used as it could be injured.

In rough adjustment, the tape transport arrangement should be checked in the playback mode of operation.

1. Check the tape on the flange guide for curl.
2. Check the tape at the inlet and outlet of the capstan for wrinkle and curl.
3. If there is any curl or wrinkle, adjust the nuts①, ②,③, and④until it is eliminated, while running the tape along the upper flange of the tape guide.
4. In adjustment, also, check the clearance between the tape and the upper flange of the tape guide using the dental mirror.

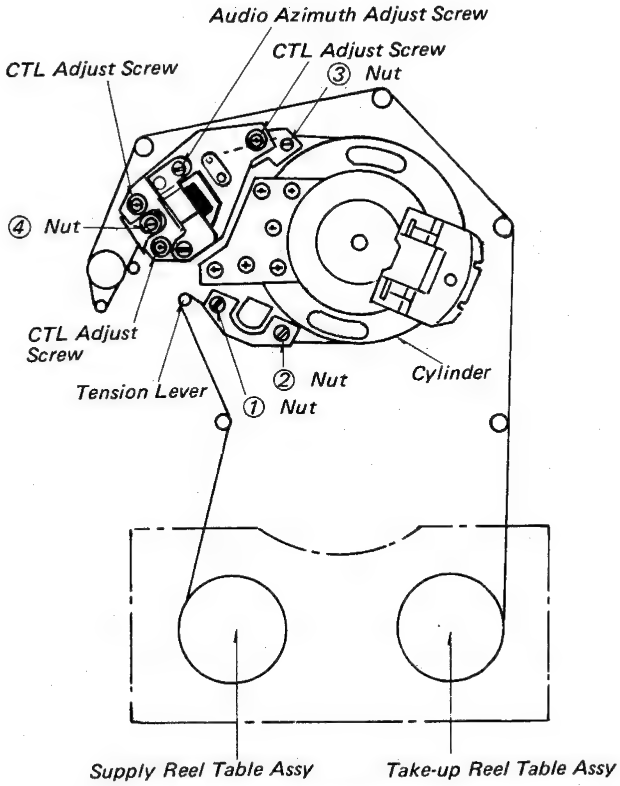


Fig. 5-83 Tape Path Adjustment.

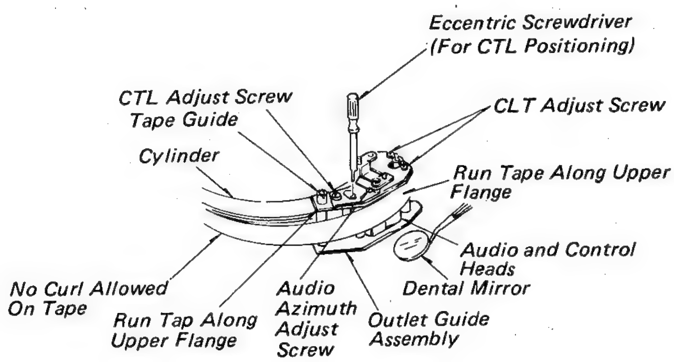


Fig. 5-84 Tape Transport Adjustment A.

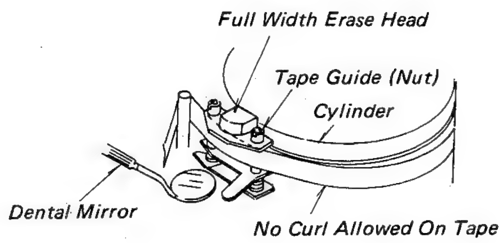


Fig. 5-85 Tape Transport Adjustment B.

(2) Video and audio head tracking adjustment

1. Connect the oscilloscope to TP105 on the Audio Circuit board (PW-2108). See Fig. 5-86.
2. Apply the external triggering signal from TP104 to the oscilloscope.
3. Play back the monochrome signal of the alignment test tape.
4. Adjust the tracking control for the best picture quality while observing the envelope waveform, with the VTVM connected to the AUDIO LINE OUT terminal for audio line output level adjustment (see Fig. 5-87).
5. Adjust the nuts ①, ②, ③, and ④ in Fig. 5-83 in accordance with paragraphs (3) and (4) below until the oscilloscope shows such an envelope waveform as in Fig. 5-88 and the audio level variation is limited to within 2 dB. (see Fig. 5-83)

(3) Inlet arrangement adjustment

1. Play back the monochrome signal of the alignment test tape.
2. Precisely adjust the nuts ① and ② until the center of the cylinder is in line with the inlet arrangement, as follows (see Fig. 5-83).
   a. Adjust the guide nut ① so that the upper or lower flange may press the tape as observed with use of the dental mirror (see Figs. 5-83, -85).
   b. Similarly, adjust the guide nut ② so that the upper flange may press the tape.
   c. If the tape is curled at the inlet guide in any way when the envelope waveform is made flat, slightly bend the tape tension lever using the tension regulator bending jig for no curl (see Figs. 5-83, -86).
   d. It is normal that the tape fluctuates slightly around the inlet as it moves in the zigzag direction.

(4) Outlet arrangement adjustment

1. Play back the monochrome signal of the alignment test tape.
2. Precisely adjust the nuts ③ and ④ until the center of cylinder is in line with the outlet arrangement, as follows (see Fig. 5-83).
   a. Adjust the guide nuts (③ and ④) so that the tape may move along the upper flange of the outlet guide assembly as observed with use of the dental mirror (see Figs. 5-83, -84).
   b. Tighten the nuts ③ and ④ little by little until the envelope waveform is made flat and so that curl may be minimized (see Figs. 5-84, -88).
   c. Check the audio level deviation is within 2 dB.
   d. Check the tape path once again, with a dental mirror, if the deviation level is high. (see Figs. 5-84, -85).

(5) Audio Azimuth Adjustment

Adjust to obtain the maximum audio level by rotating the audio azimuth adjustment screw. (see Fig. 5-84).

NOTE:-No adjustment of audio head height is necessary, as it can be viewed by having the tape run along the tape outlet guides ③ and ④ . DO NOT turn the slotted screw painted with RED ENAMEL. (see Fig. 5-83).

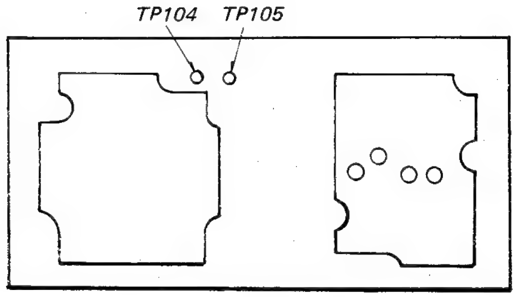


Fig. 5-86 Audio Circuit Board (PW-2108).

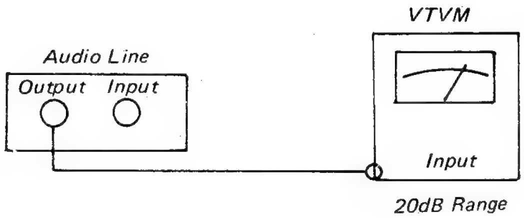


Fig. 5-87 Audio Line Output Level Adjustment.

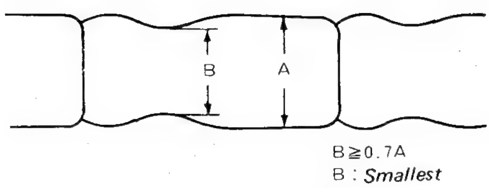


Fig. 5-88 Envelope Waveform.

(6) CTL Position Adjustment (see Fig. 5-84)

1. Play back monochrome signal from alignment tape.
2. Set the tracking control knob at the center, detent, position.
3. Loosen the three (3) screws for the CTL adjustment and adjust the position of the CTL head with an eccentric screwdriver so that the RF output of TP105 on the printed circuit board PW-2108, reaches its maximum output.
4. Verify that the Audio/CTL head is positioned at about the center of the notch in the guide base.
5. Retighten the three screws for the CTL adjustment.

5-3 PUSH BUTTON ACTION DESCRIPTION

5-3-1 Playback Mode

PLAY button is depressed → Play slider ① is moved in the arrow direction

→ EE switch lever ⑩ is turned in the arrow direction to press slide plate → Slide plate switches over EE switch ⑫

→ Play lever ③ is turned in the arrow direction → Play link ④ is slid in the arrow direction being pulled by pinch lock spring ⑨

→ Pinch lock lever ⑤ is turned in the arrow direction → Pinch roller ⑬ is tightened to the capstan

→ Pinch lock lever ⑤ is unlocked → Slack lever ⑥ turns in the arrow direction by force of slack lever spring

→ Slack lever ⑥ detects slack of tape, (if any)

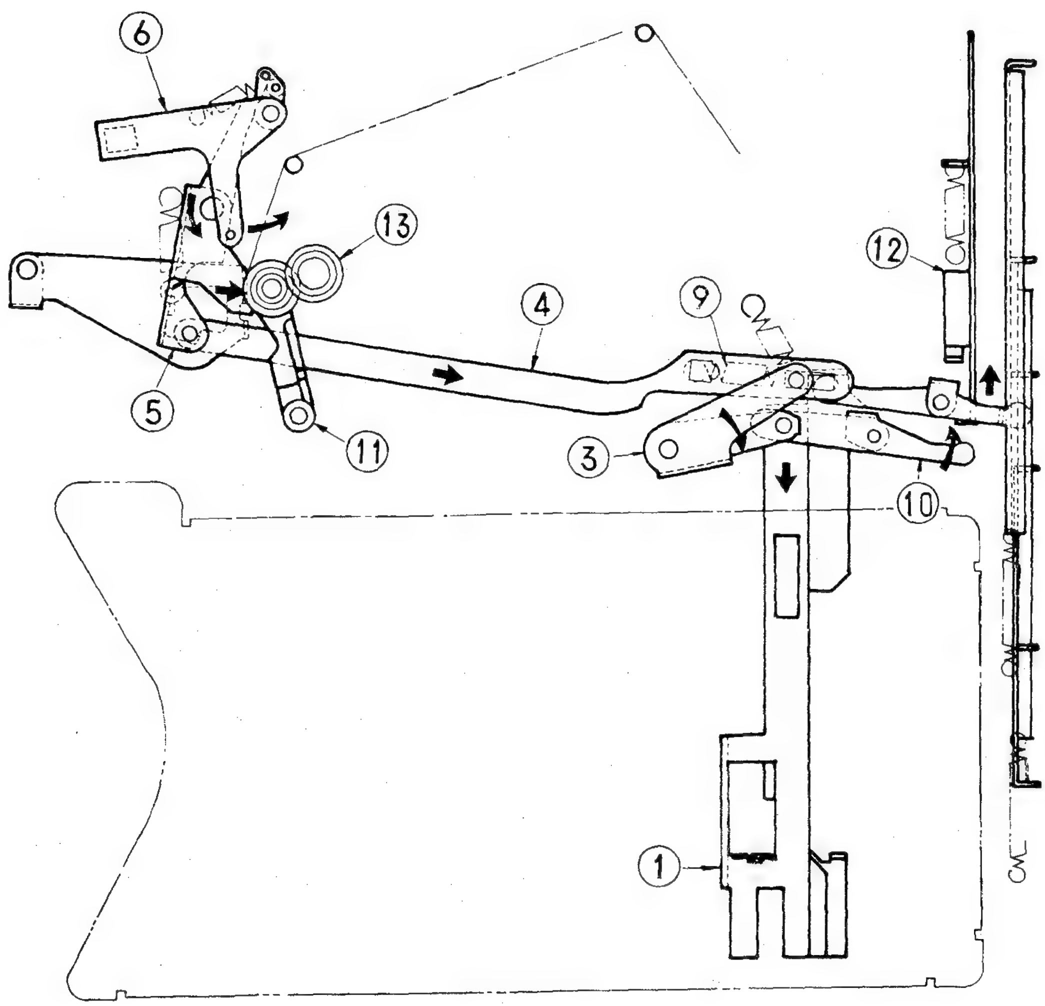


Fig. 5-89

5-3-2 Recording Mode

REC button is depressed → Play slider ① and record slider ② are moved in the arrow direction

→ Play slider ① performs the same operation as in playback mode (5-3-1)

→ EE switch ⑫ is not switched over as record slider ② pulls EE switch lever ⑩ in the arrow direction → Record lever ① is turned in the arrow direction

→ Record switch slider ⑯ is pressed to slide Audio-Dubbing slider ⑰ together in the arrow direction → Record sub-lever ⑮ and Audio-Dubbing sub-lever ⑭ are slid in the arrow direction by spring to switch over the record switch ⑱ and Audio-Dubbing switch ⑲

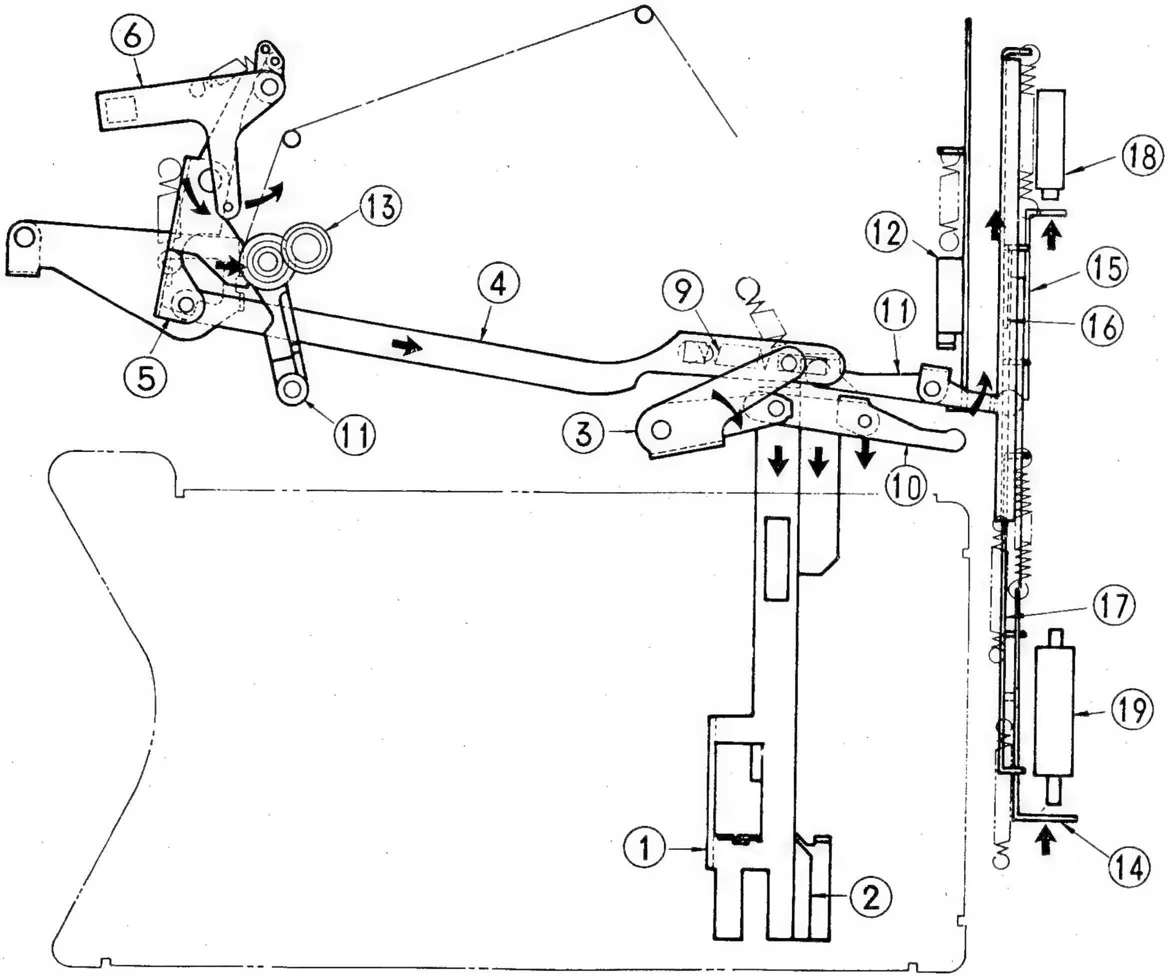


Fig. 5-90

5-3-3 Audio-Dubbing Mode

AUDIO DUB button is depressed while PLAY button is depressed → Audio-Dubbing slider ⑳ is moved in the arrow direction → Audio-Dubbing lever ㉑ is turned in the arrow direction → Only Audio-Dubbing switch slider ⑰ is pressed to slide in the arrow direction → Audio-Dubbing slider ⑭ is slid by spring to switch over Audio-Dubbing switch ⑲

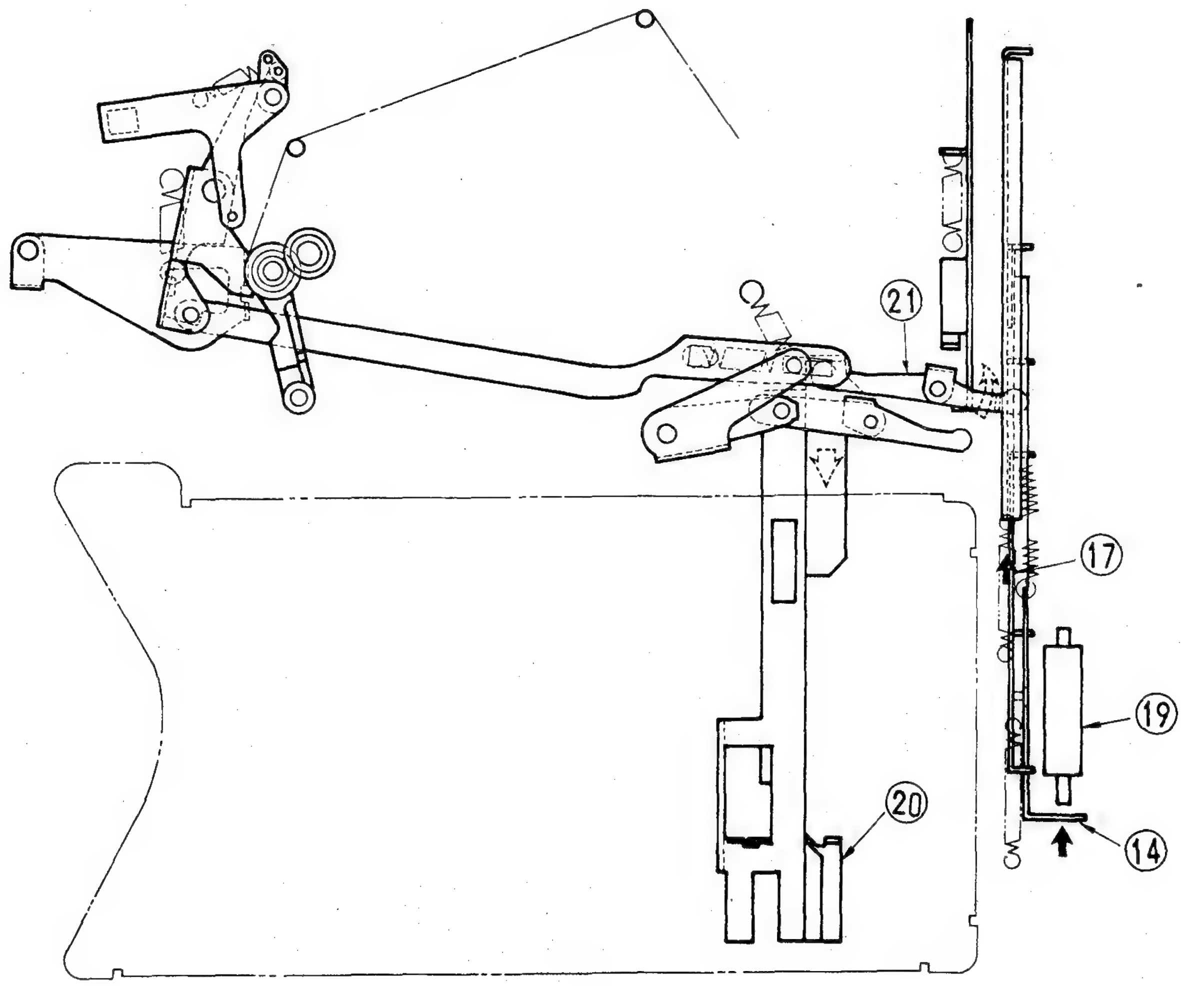


Fig. 5-91

5-3-4 Fast-Forward Mode

FF/P.SEARCH button is depressed → Fast-forward slider ⑦ is moved in the arrow direction

→ Fast-forward idler ㉙ is turned in the arrow direction by the spring on fast-forward idler ㉙ to be tightly pressed against the reel table, which is turned "Fast-Forward"

→ Cam lever ㉒ is turned in the arrow direction → Play idler ㉓ is pulled away in the arrow direction from reel table

→ Connector ㉔ is pressed in the arrow direction → Fast-forward brake ㉖ is tightly pressed to the reel table through the fast-forward connector ㉕

→ Tension lever ㉗ is turned in the arrow direction to a pre-determined position through tension release lever → Turning of tension lever ㉗ loosens brake band ㉘

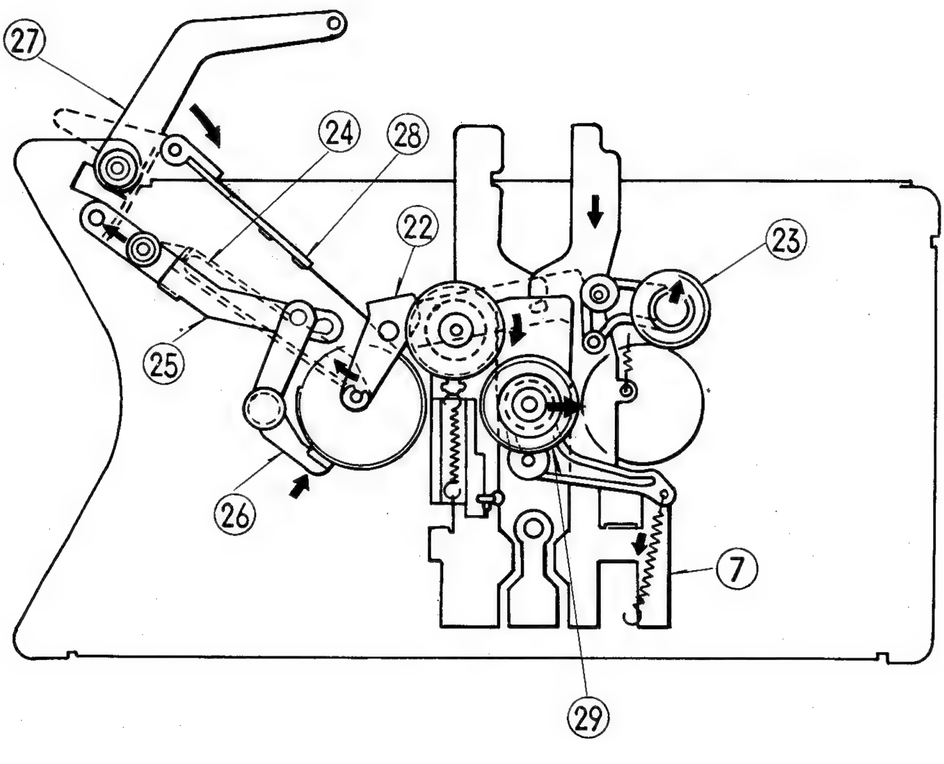


Fig. 5-92

5-3-5 Rewind Mode

REW/P.SEARCH button is depressed → Rewind slider ⑧ is moved in the arrow direction

→ Rewind idler ㉚ is slid in the arrow direction by the spring on rewind idler ㉚ to be tightly pressed against both the fast-forward idler ㉙ and supply reel table, which are being rewound

→ Cam lever ㉒ is turned in the arrow direction → Play idler ㉓ is pulled away in the arrow direction from reel table

→ Connector ㉔ is pressed in the arrow direction → Fast-forward brake ㉖ is tightly pressed to the reel table through fast-forward connector ㉕

→ Tension lever ㉗ is turned in the arrow direction to a pre-determined position through the tension release lever → Turning of tension lever ㉗ loosens brake band ㉘

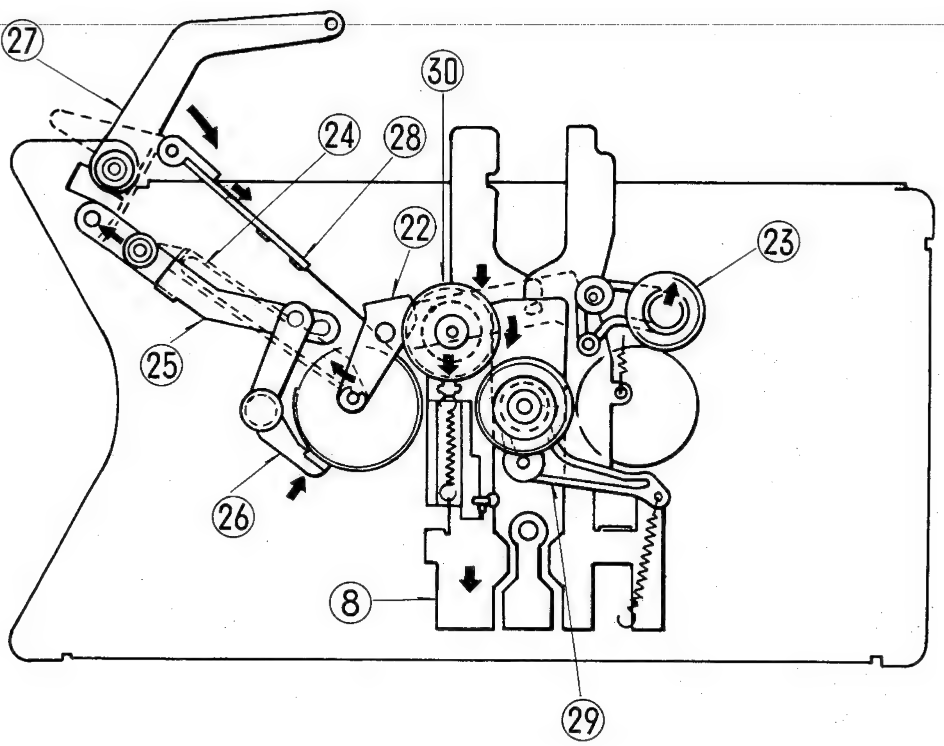


Fig. 5-93

5-3-6 Eject Mode

EJECT button is depressed

- Eject slider (31) is moved in the arrow direction → Eject lever (1) (32) is turned in the arrow direction
  - Brake lock lever (33) is turned in the arrow direction → Ring detect lever (34) is turned in the arrow direction; Supply brake (35) is tightly pressed against the reel table by the spring of the reel brake
  - Eject lever (2) (37) is turned in the arrow direction by torque arrangement to pull lockout spring (38), which exerts force to the eject connector (1), (39) in the arrow direction. Note that in this state, eject connector (1) (39) cannot be moved.
- Eject leaf switch feeds out an unloading signal, which actuates loading ring (40) to run in the arrow direction → Detect lever (41) comes to (A) position of loading ring (40)

Force is transmitted from lockout spring (38) to eject connector (1) (39), from that to the eject arm (42). Eject arm (42), in turn, turns the detect lever (41) in the arrow direction and, the roller of the detect lever (41) gets into ditch of the loading ring, at the same time the detect lever (41) is locked by the pawl of the cassette detect lever (49), so that loading ring is locked, and revolves locker (44) in the arrow direction through eject wire (43) to unlock lifter (45)

Lifter (45) is lifted up by the lifter spring →
- Recording safety bracket (46) is lifted up in the arrow direction to semi-lock locker (44)
- Lockout lever (47) presses button locker (48) to unlock push button and to lift cassette compartment up

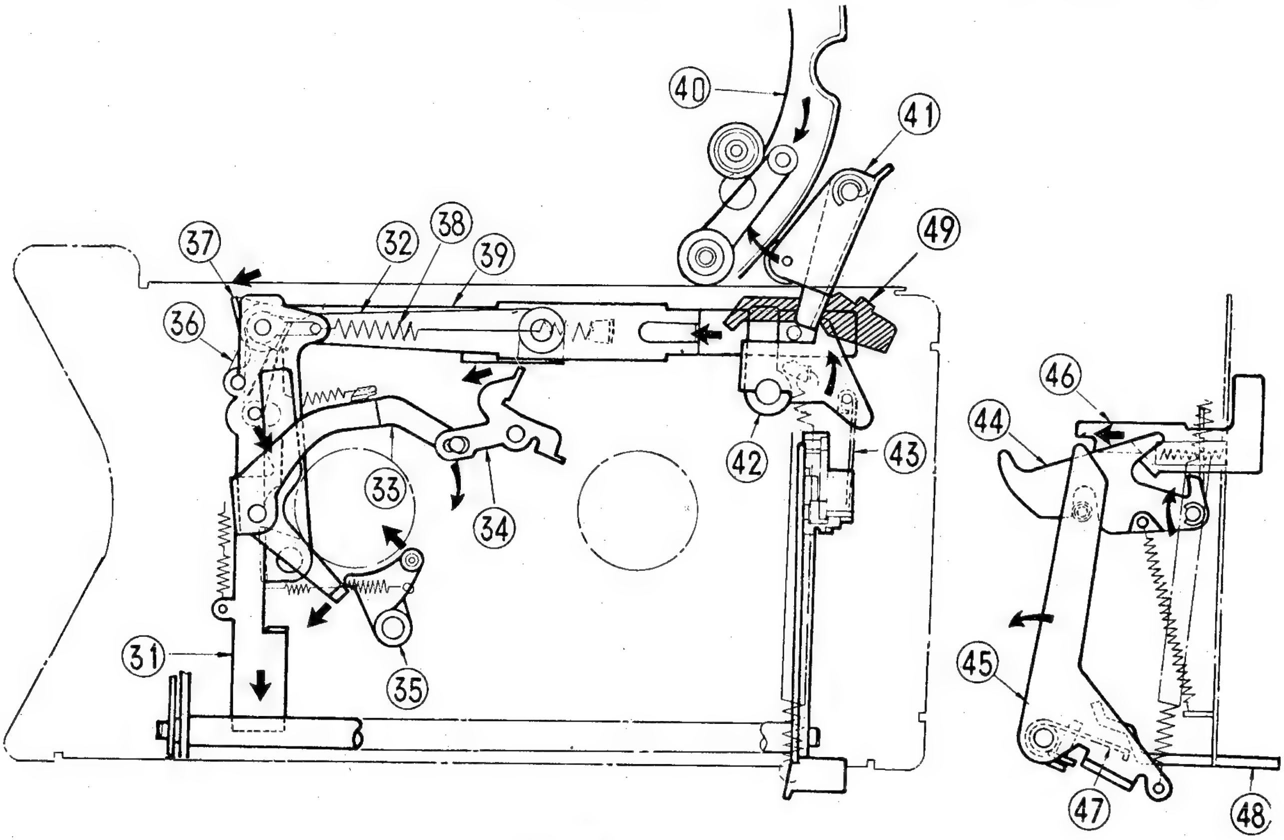


Fig. 5-94

5-3-7 Picture Fast-Forward Mode (Cue mode)
(see Fig. 5-95, -96, -97)

5-3-1 Set the VTR to the playback mode.

↓

FF/P.SEARCH button is depressed

↓

FF slider ⑦ and FF sub-slider ㉙ move in the arrow direction. In this case, playback button ㉛ is locked while FF/P.SEARCH button is not locked. The reason is as follows. Locker has a main locker ㉜ and sub-locker ㉝ .
Playback button is locked by the main locker ㉜ while FF/P.SEARCH button by sub-locker. Playback button, if depressed, presses down the sub-locker which locks the FF/P.SEARCH button.
Thus the FF/P.SEARCH button, even if depressed, cannot be locked by sub-locker. To prevent the FF/P.SEARCH button from being depressed with REW/P.SEARCH button simultaneously, this set is equipped with a seesaw ㉚ which can move freely. When pulling the FF slider ⑦ , the seesaw ㉚ moves in the arrow direction, thereby locking the REW slider.

↓

The real table moves as in FF mode described in item 5-3-4

↓

Tension release lever ㊿ moves in the arrow direction through FF brake connector ㉕ .

↓

The pause brake lever (52) moves in the arrow direction through the pause brake link (51) , thereby making the pause brake inoperative.

↓

Pause solenoid (55) comes in action

↓

Pinch lock lever ⑤ moves in the arrow direction through pause lever (54)

↓

Pinch roller ⑪ separates from the capstan ⑬ .

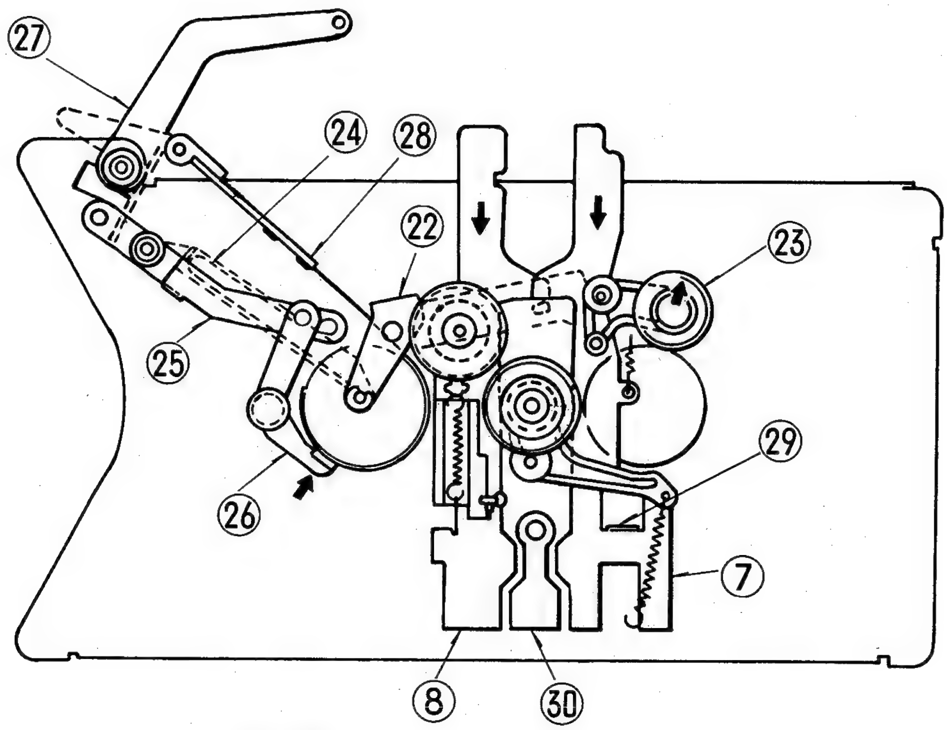


Fig. 5-95

5-3-8 Picture Rewind Mode (Review mode) (see Fig. 5-95, -96)

5-3-1 Set the VTR to the playback mode

↓

REW/P.SEARCH button is depressed

↓

REW slider ⑧ moves in the arrow direction. In this case, REW/P.SEARCH button is not locked, while playback button is locked as in FF mode. To prevent the REW/P.SEARCH button from being depressed simultaneously with FF button the seesaw moves in the arrow (⇨) direction by pulling the REW slider, thereby locking the FF slider.

↓

The reel table moves as in REW mode described in item 5-3-5.

↓

Tension release lever 50 moves in the arrow direction through FF brake connector 25

↓

Pause brake lever 52 moves in the arrow direction through pause brake link 51 , thereby releasing pause brake

↓

Pause solenoid 55 comes in action

↓

Pinch roller lever ⑤ moves in the arrow direction through pause lever

↓

Pinch roller 11 separates from the capstan 13 .

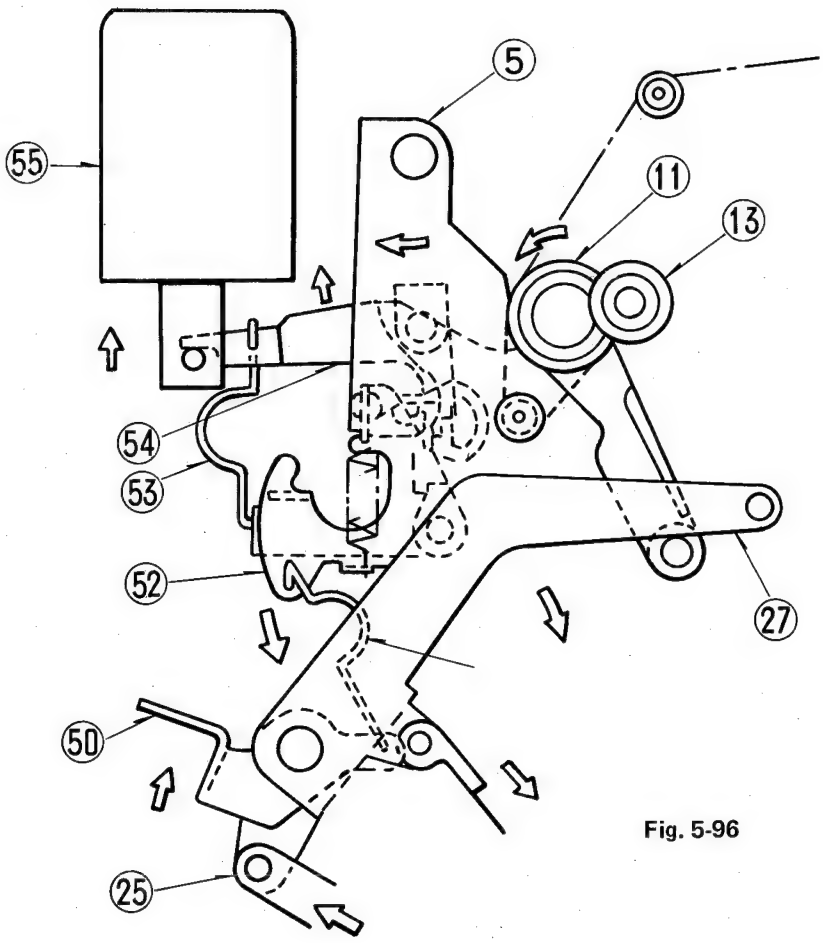


Fig. 5-96

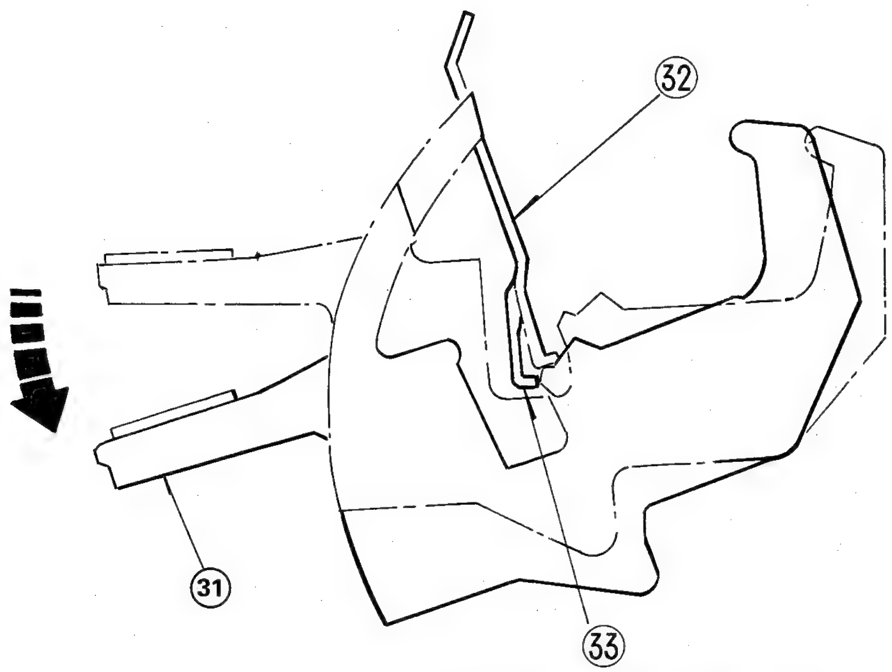


Fig. 5-97 Locker and Sub Locker

NOTE:-Definite Tension post positioning device

The definite tension post positioning device is employed for the purpose of keeping the tape-path which serves to produce a playback picture in FF or Rew mode. A movable L shaped stopper ⑨ which is pressed in clockwise direction by tension spring ⑩ is mounted on the ring detect slider ⑧ which operates detecting the loading end. On the other hand, the fan shaped tension sub-lever ⑦ is mounted on the tension lever ③ . The stopper ⑨ is designed to situate on the moving track of the tension lever. Thus, in FF, REW or CUE (REVIEW) mode, the tension release lever ⑤ which moves the tension lever in the clockwise direction fix the tension lever ③ between stopper ⑨ and tension release lever ⑤ . In REW mode, tension lever returns to the position where the tension lever is to be fixed in case of reduce of tension, causing to return the stopper ⑨ to the definite position and fix the tension lever ③ . In case of unloading, ring detect slider ⑧ operates to release the stopper ⑨ by means of movement of tension sub-lever and tension lever moves in the direction.

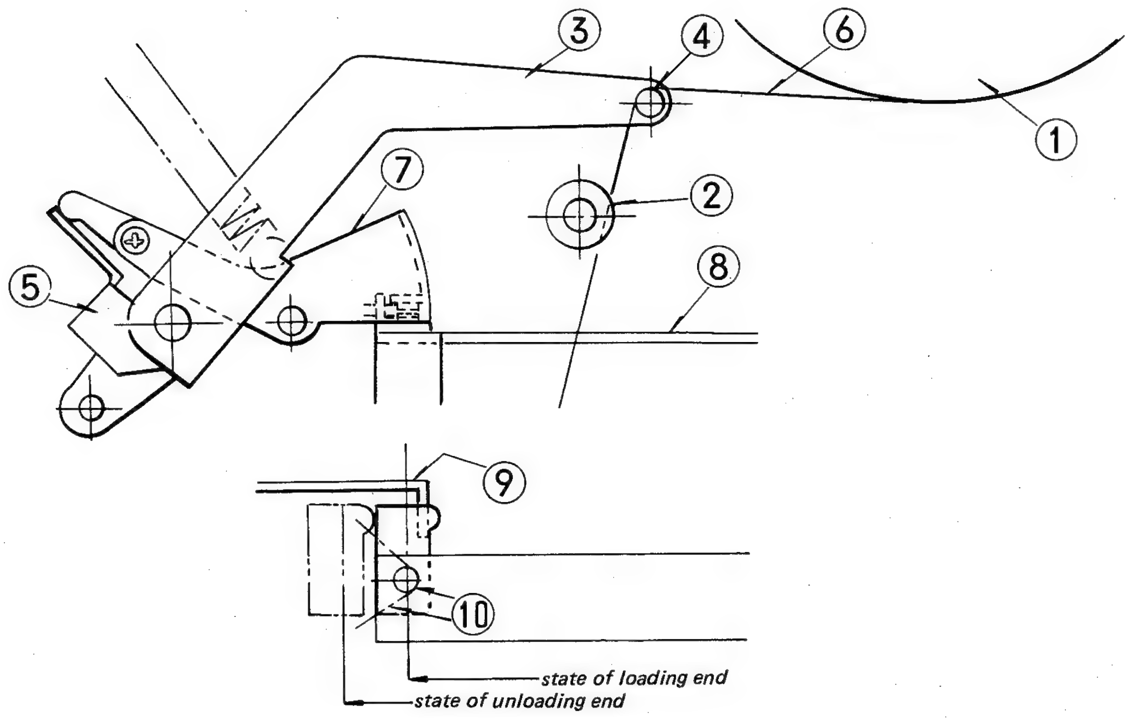


Fig. 5-98

SECTION 6 MAINTENANCE

6-1 PERIODIC INSPECTION AND MAINTENANCE

6-1-1 Maintenance Items and Period

The V-5470 should be maintained for best performance at all times in accordance with the table below.

NOTE:-For cleaning, use isopropyl alcohol.

ITEM \ PERIOD (HOURS)	500	1000	1500	2000	2500	3000	3500	4000	5000
Video head disk assembly	▽	▽○	▽	▽ ○	▽	▽○	▽	▽○	▽○
Audio and control head assembly	▽	▽	▽	▽	▽	▽○	▽	▽	▽
Capstan assembly		▽ ▲		▽ ▲		▽ ▲	▽○▲		▽ ▲
Capstan bearing assembly		▽ ▲		▽ ▲		▽ ▲		▽○▲	▽ ▲
Pinch roller	▽	▽		▽		▽○		▽	▽
Dew sensor element				▽				▽	
Guide pulley belt				○				○	
Capstan belt				○				○	
Play belt				○				○	
Fast-forward belt				○				○	
Counter belt				○				○	
Supply reel table assembly				▽ ▲				▽ ▲	
Take-up reel table assembly				▽ ▲				▽ ▲	
Play idler assembly				○					
Fast-forward idler assembly				▽○				▽○	
Rewind idler assembly				▽○				▽○	
Guide pulley belt				▽ ▲				▽ ▲	
Band brake assembly				○				○	
Supply brake				○				○	
Disk motor						○			
Tape guide and the like	▽	▽	▽	▽	▽	▽	▽	▽	▽
Capstan motor						○			
Loading drive assembly				▲				▲	○

NOTE:-○ indicates replacement, ▲ lubrication, and ▽ cleaning.
For replacement, refer to the "Service Bulletin"

CAUTION:-For lubrication, the Toshiba's LK-100 Lubrication Kit should be used.
Never apply excess oil to any part as it would be splashed by part revolution, causing malоperation.

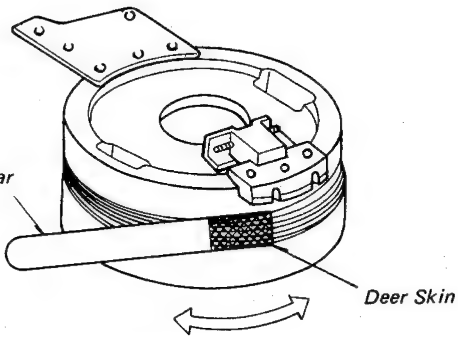


Fig. 6-1

6-1-2 Cleaning the Video Heads (see Fig. 6-1)

To clean the video heads, wipe them with a cleaning bar of deer skin moistened in isopropyl alcohol.

CAUTION:-Never leave the video heads revolving during cleaning or they could be damaged.
The heads and cylinder should be cleaned by lightly wiping the cleaning bar right and left on the surface as shown in Fig. 6-1.

6-1-3 Cleaning the Audio and Control Heads and Full Width Erase Head

To clean the audio and control heads and master erase head, wipe the cleaning head right and left on the surface as shown in Fig. 6-2.

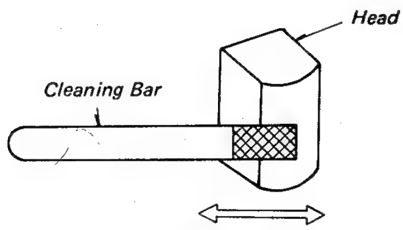


Fig. 6-2

6-1-4 Cleaning the Capstan Assembly and Capstan Bearing Assembly

To clean these assemblies, first remove the cabinet as directed in Section 5-1-2, the "Removing the Cabinet". Remove the two screws holding the Video Circuit board (PW-2109) located on the bottom of the VTR body. Take out the video board. Now, clean the assemblies.

6-1-5 Cleaning the Belts, Idlers, and Pulleys

To clean these parts, use a cleaning rod having cotton at each end or a cloth moistened a little in isopropyl alcohol.

CAUTION 1:- Disconnect all power from the VCR before cleaning any parts.
2:- Each flat belt should be installed with the white mark facing outside and the arrow indicating the revolutional direction as shown in Fig. 6-4 .

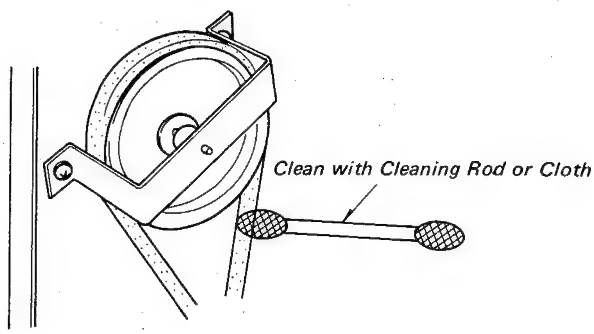


Fig. 6-3

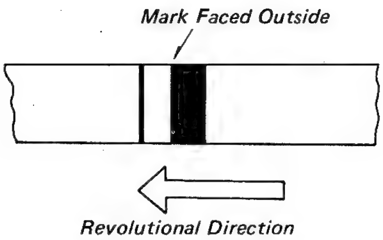


Fig. 6-4 Mark of Flat Belt

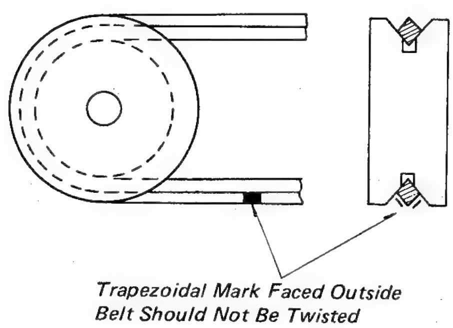
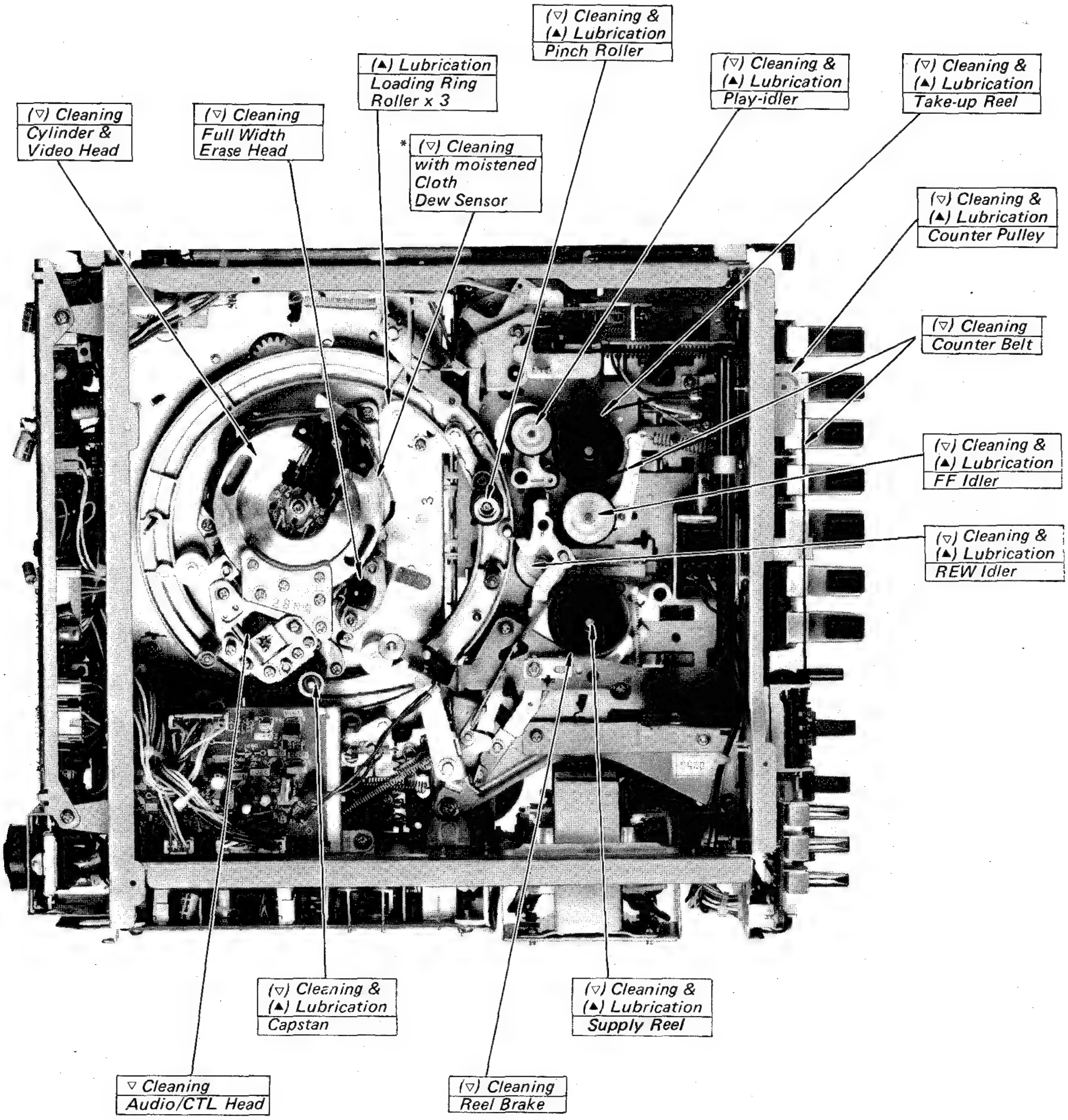


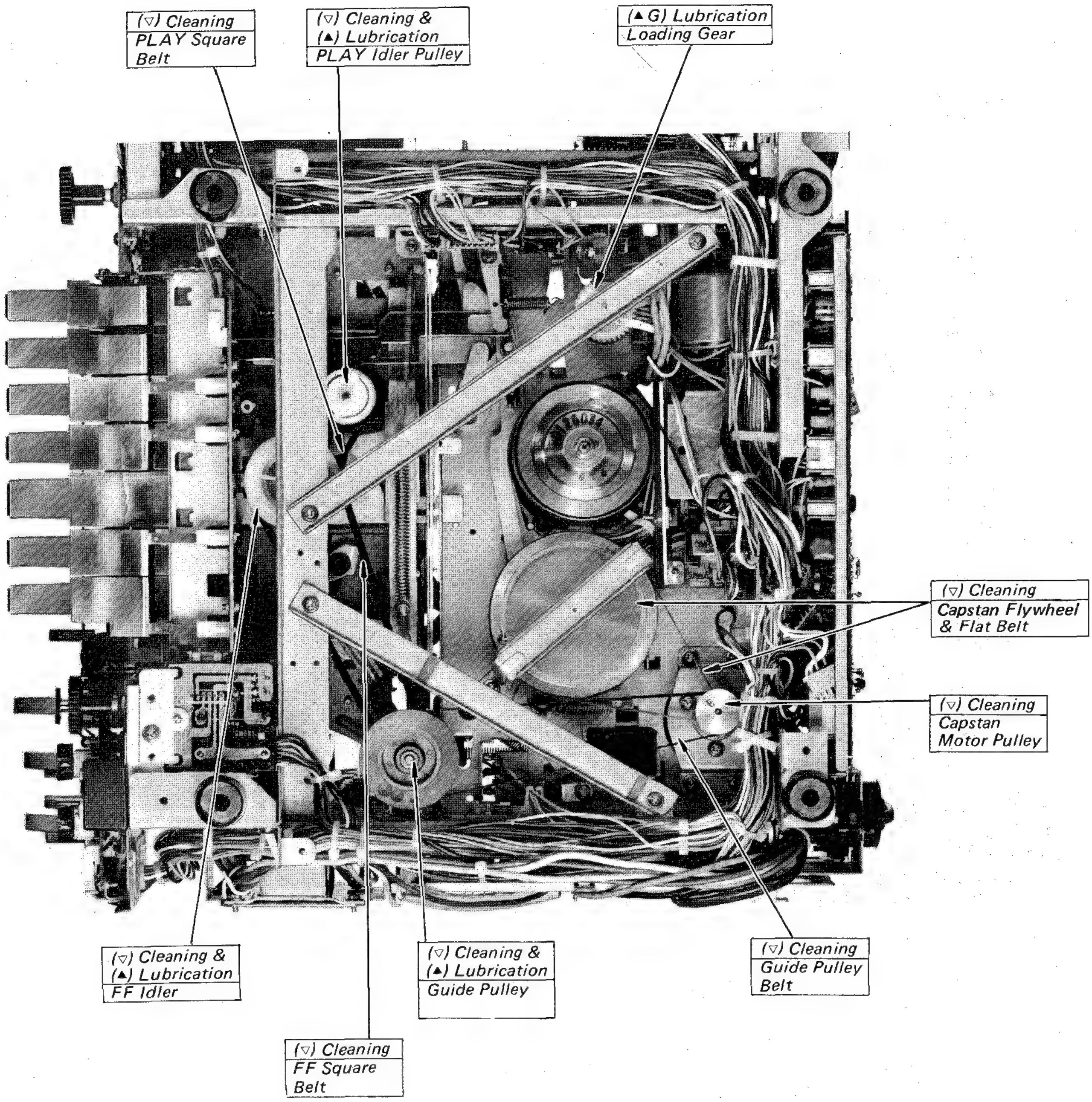
Fig. 6-5 Reel-Drive Belt

6-1-6 Parts to be Cleaned on Top of Chassis



Remarks:	*▽ mark*	*Cleaning*
	▲ mark	*Lubrication (oil specified)*
	▲G mark	*Greasing*
Note 1.	** mark*	*Cleaning with slightly moistened cloth*
Note 2.	*⇒ mark*	*Cleaning of Tape Guide*

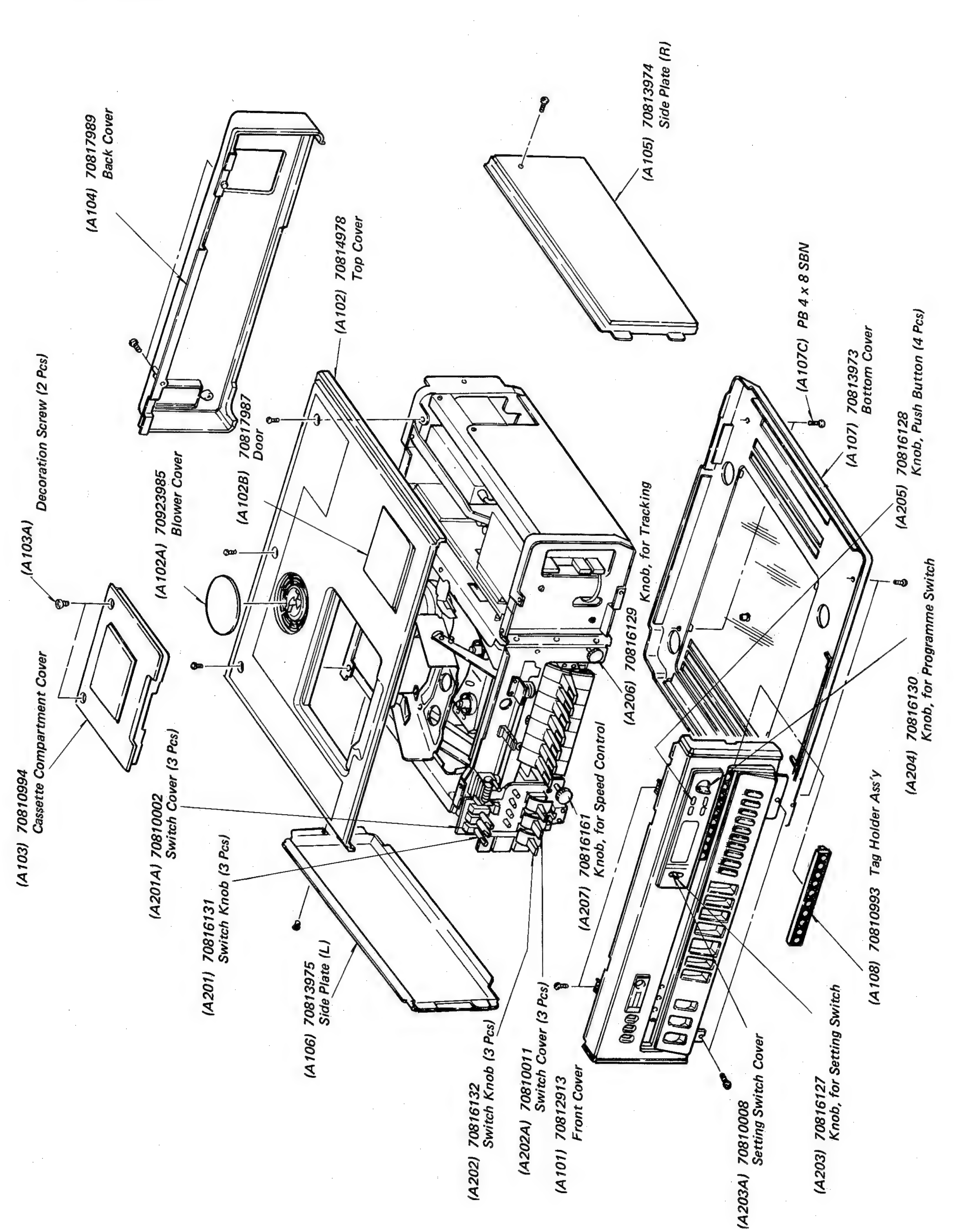
6-1-7 Parts To Be Cleaned on Bottom of Chassis



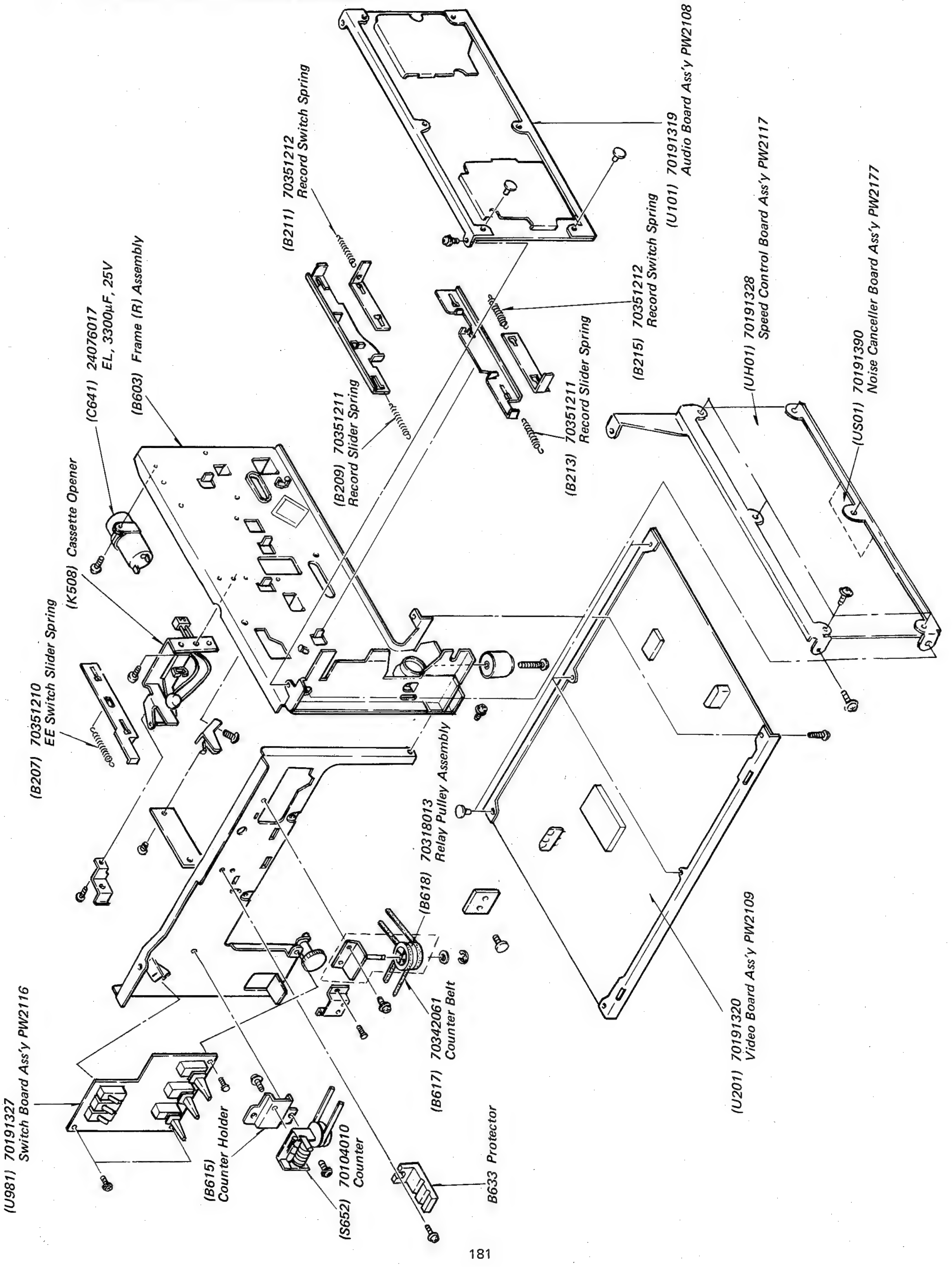
Remarks: ▽ mark Cleaning
▲ mark Lubrication (oil specified)
▲ G mark Greasing

SECTION 7 EXPLODED VIEWS

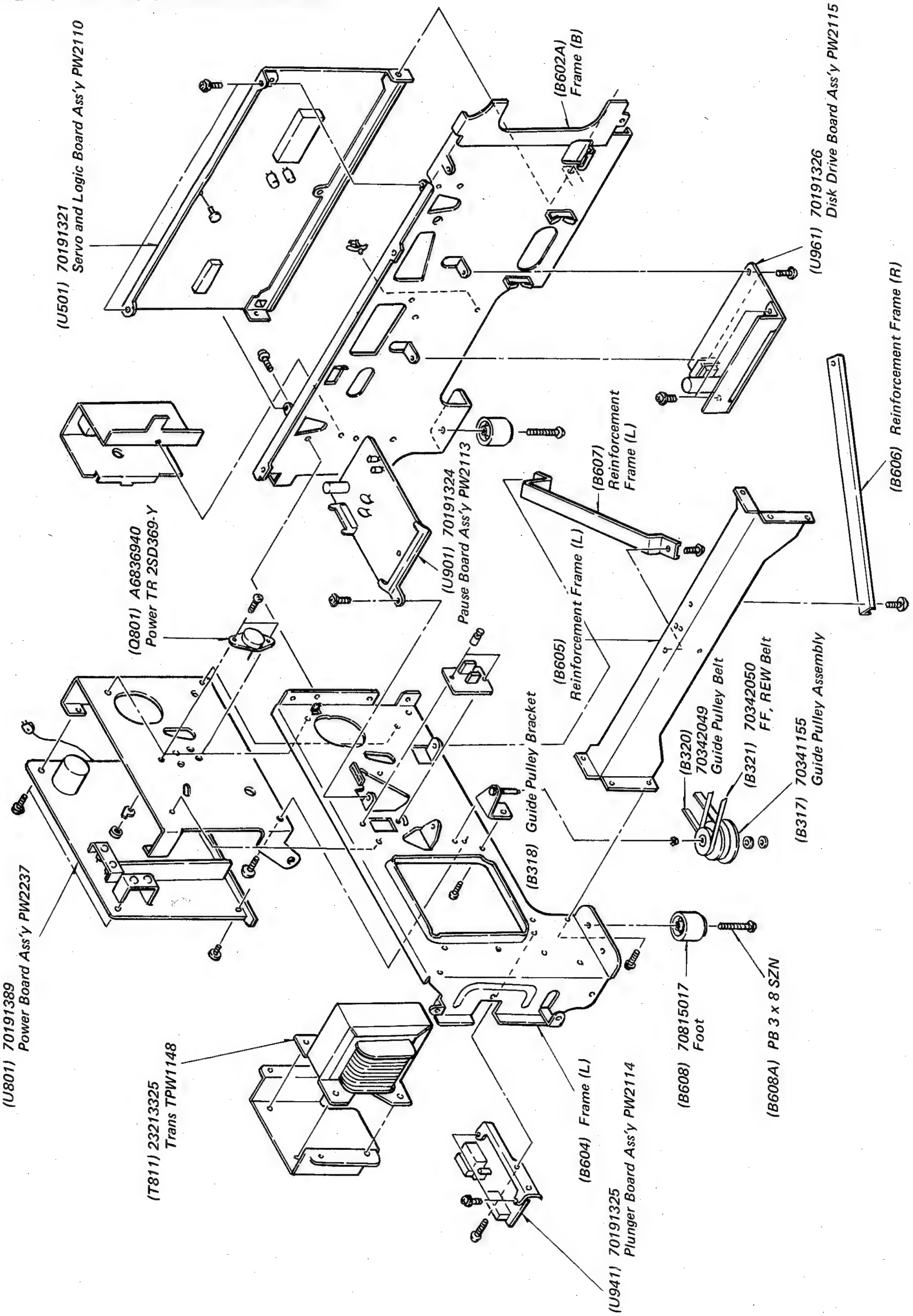
(1) CABINET ASSEMBLY



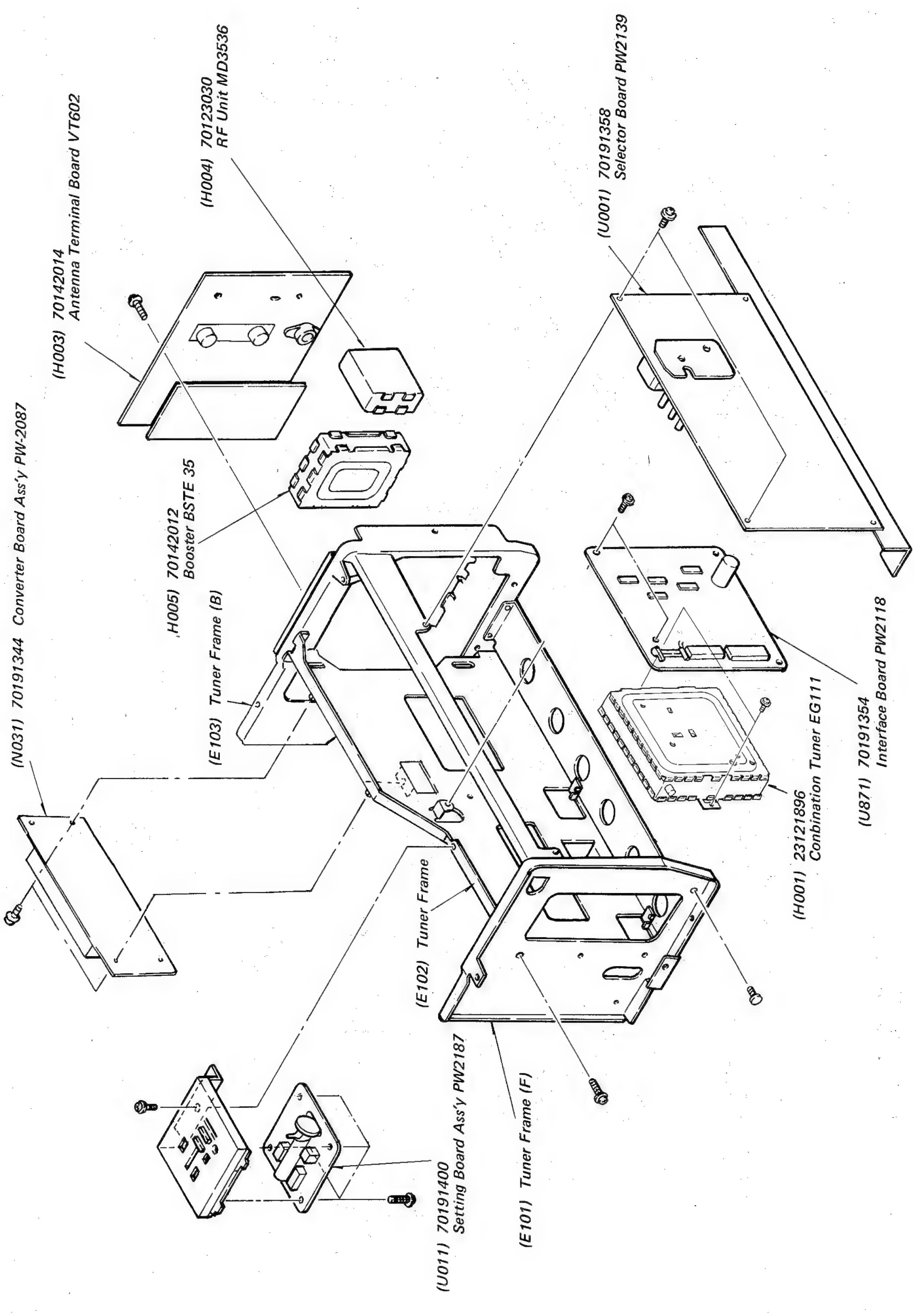
(2) FRONT AND RIGHT CHASSIS ASSEMBLY



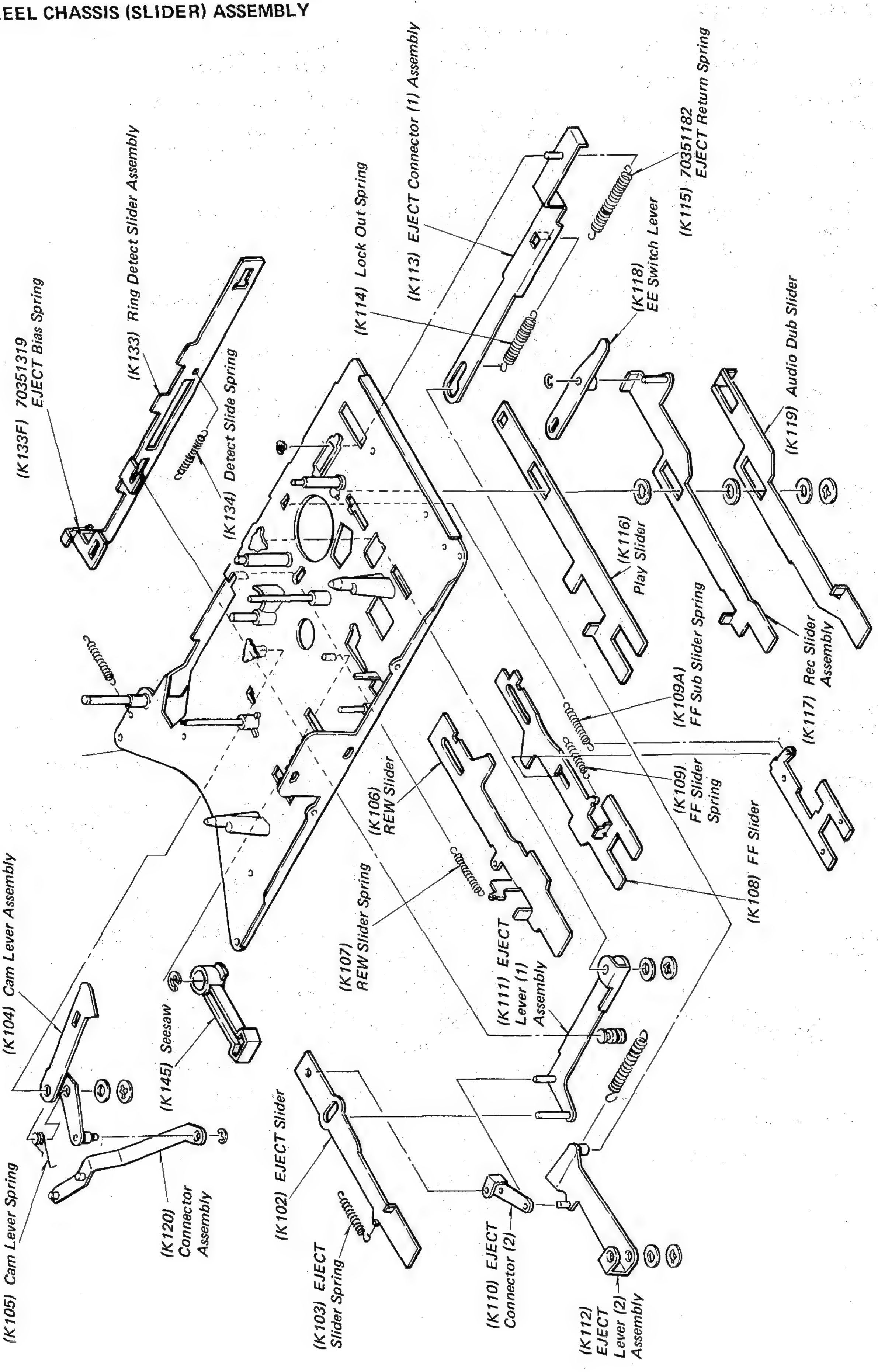
(3) LEFT AND BACK CHASSIS ASSEMBLY



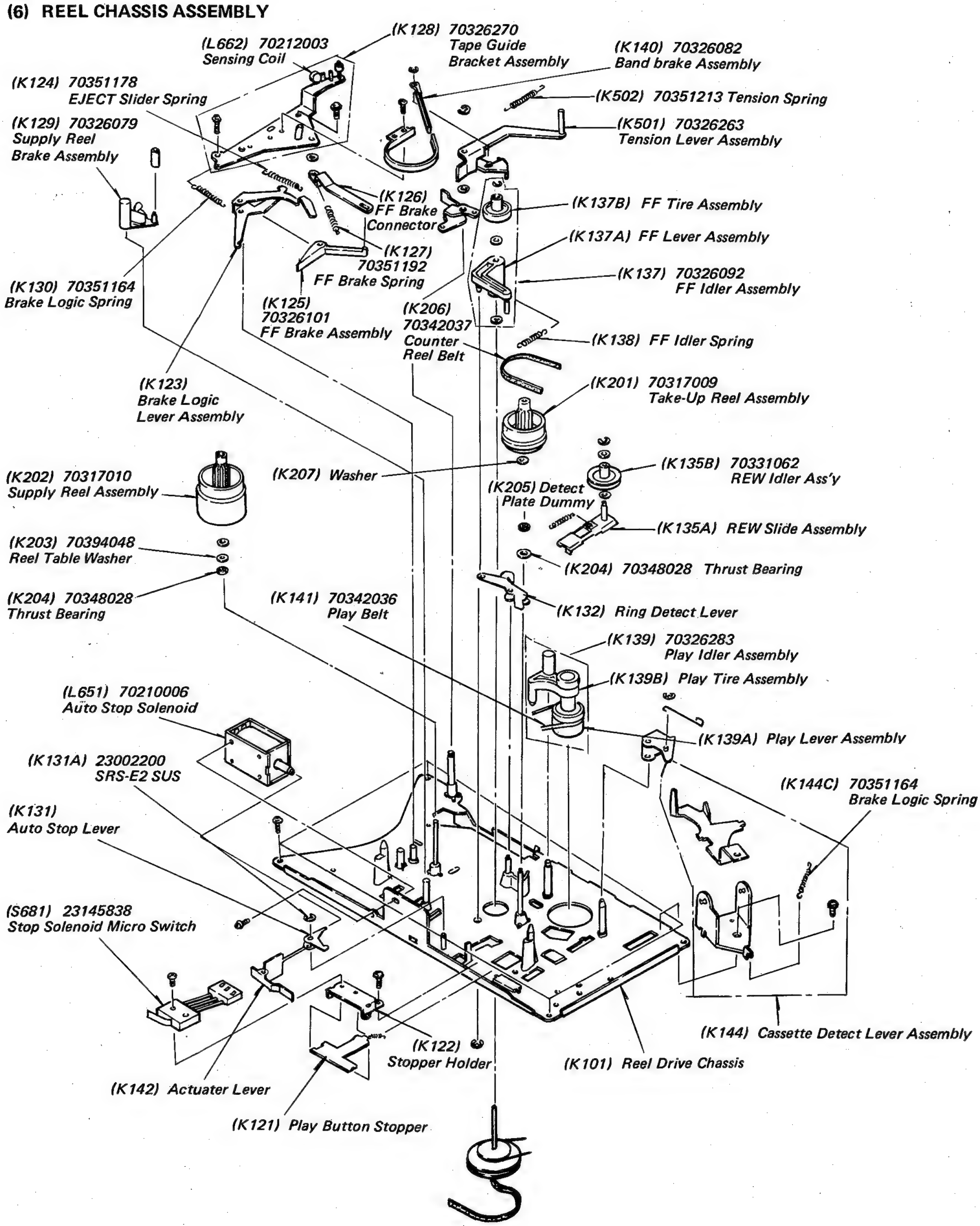
(4) TUNER BLOCK ASSEMBLY



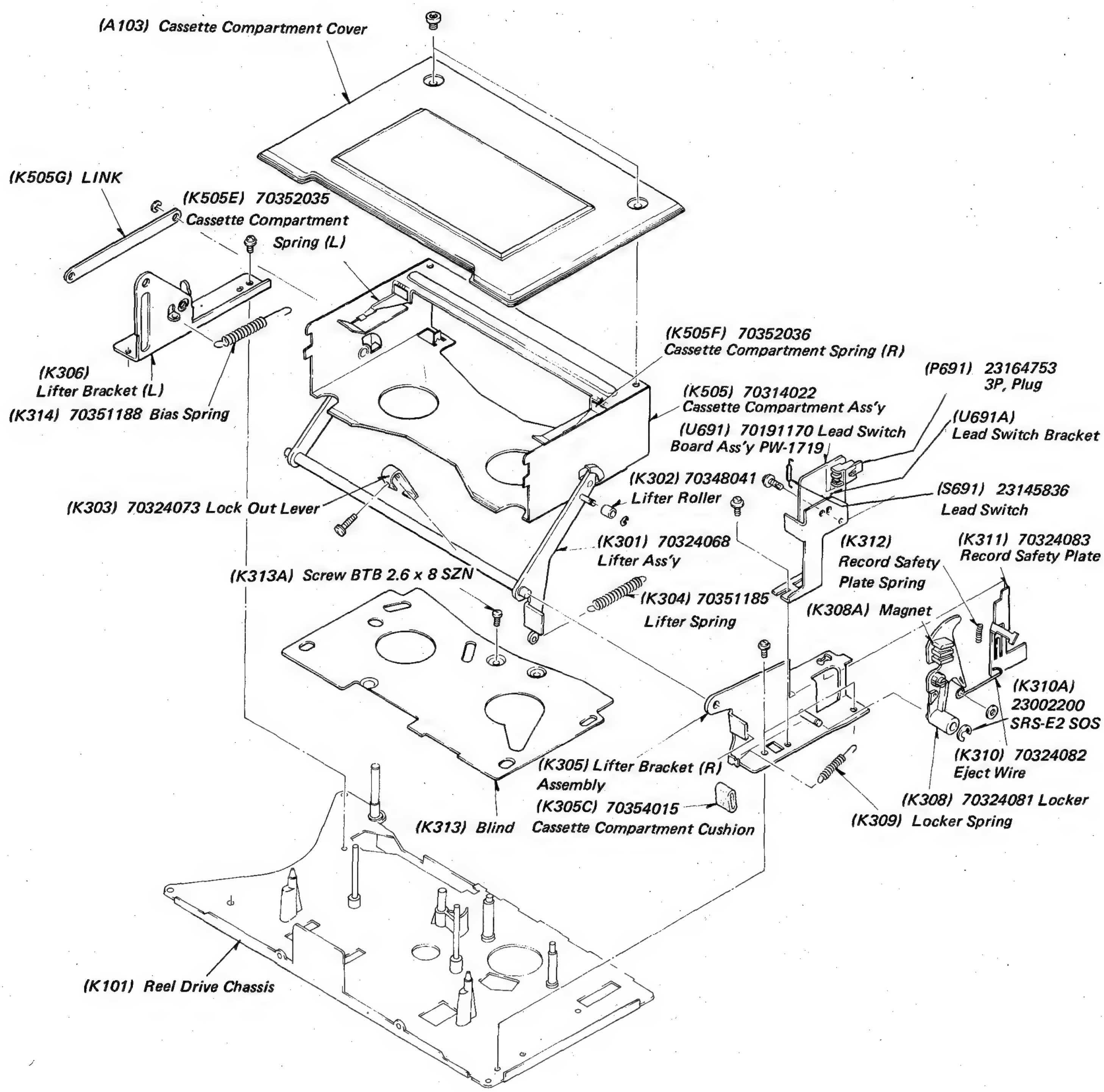
(5) REEL CHASSIS (SLIDER) ASSEMBLY



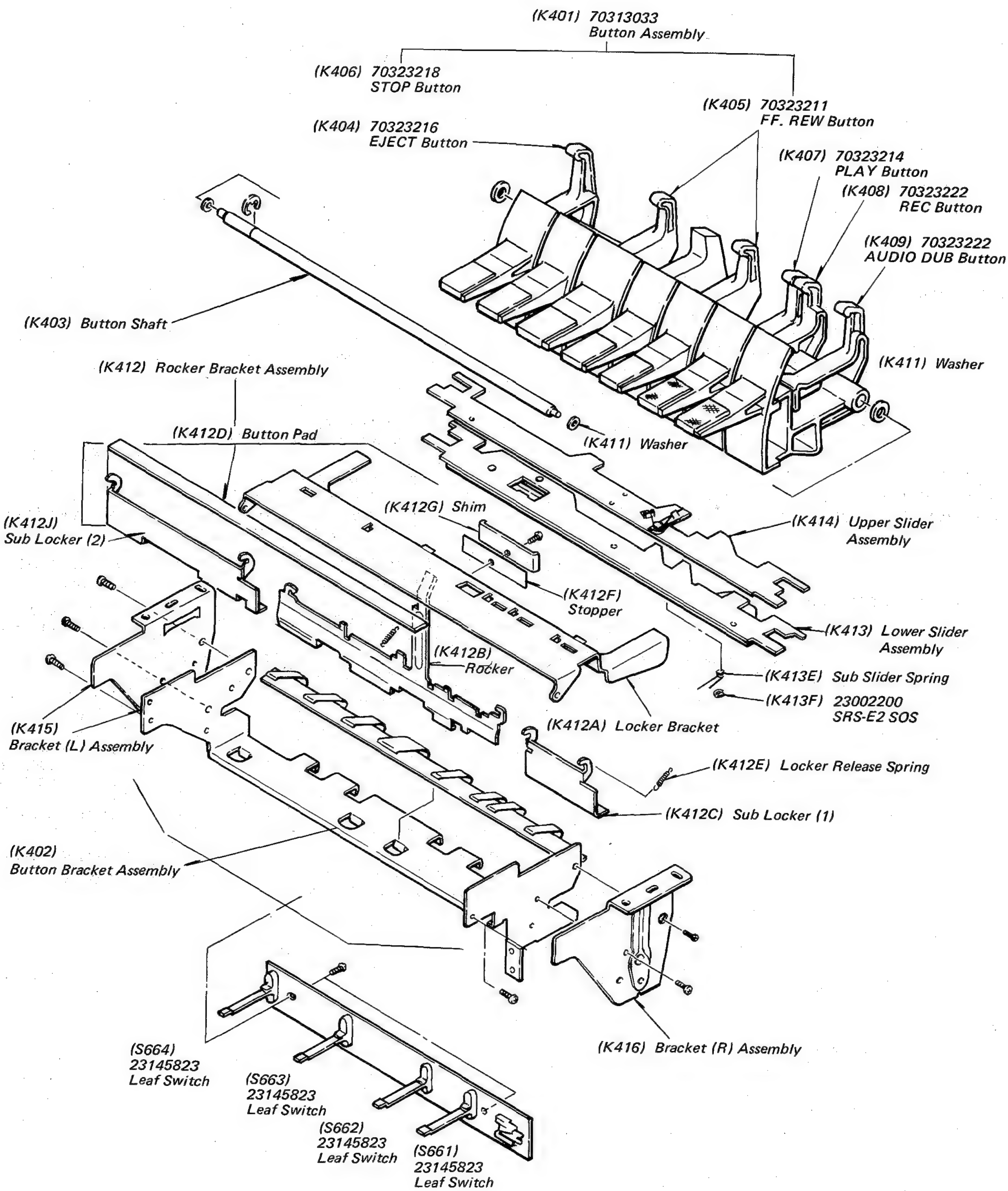
(6) REEL CHASSIS ASSEMBLY



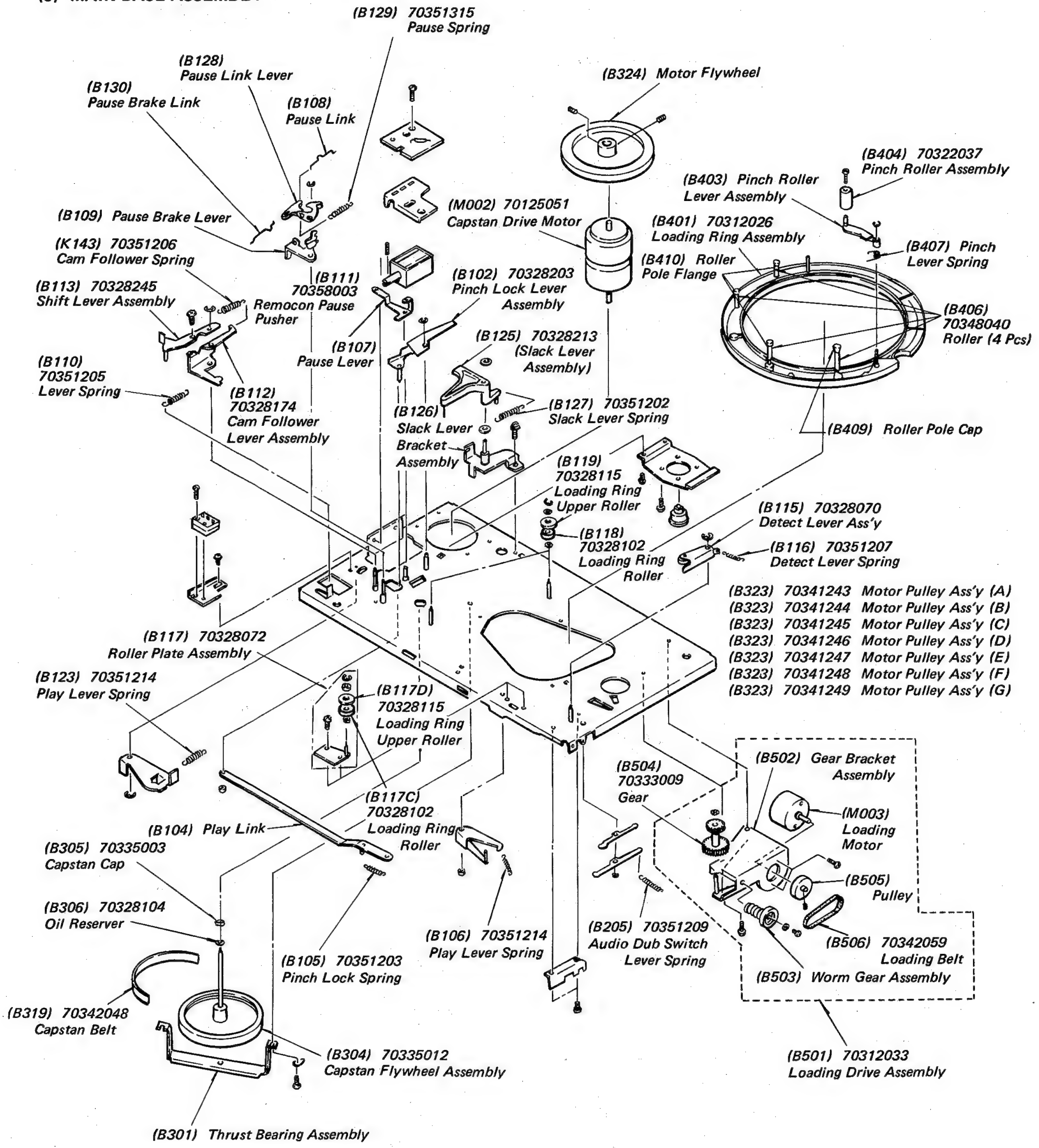
(7) CASSETTE COMPARTMENT ASSEMBLY



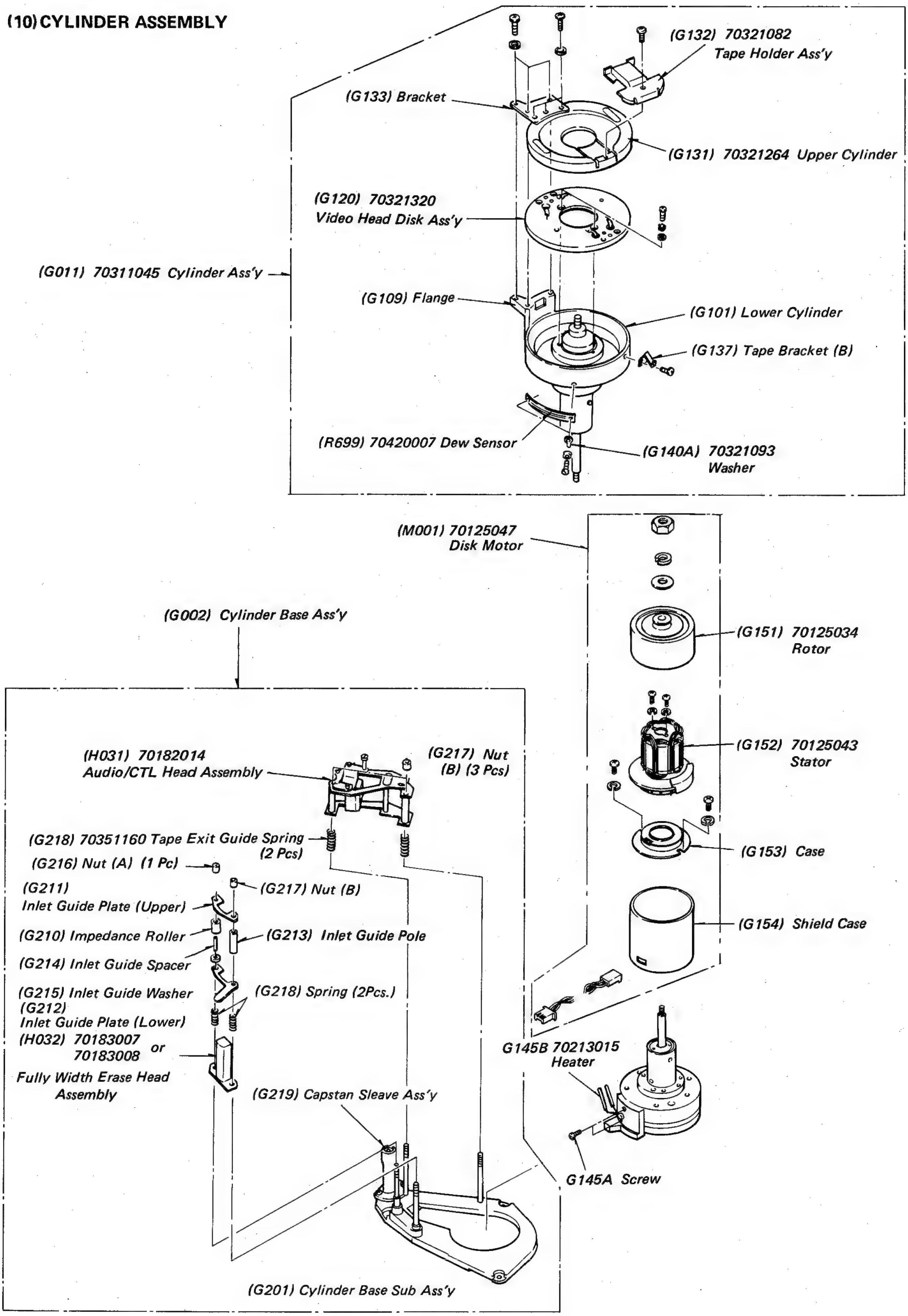
(8) PUSH BUTTON ASSEMBLY



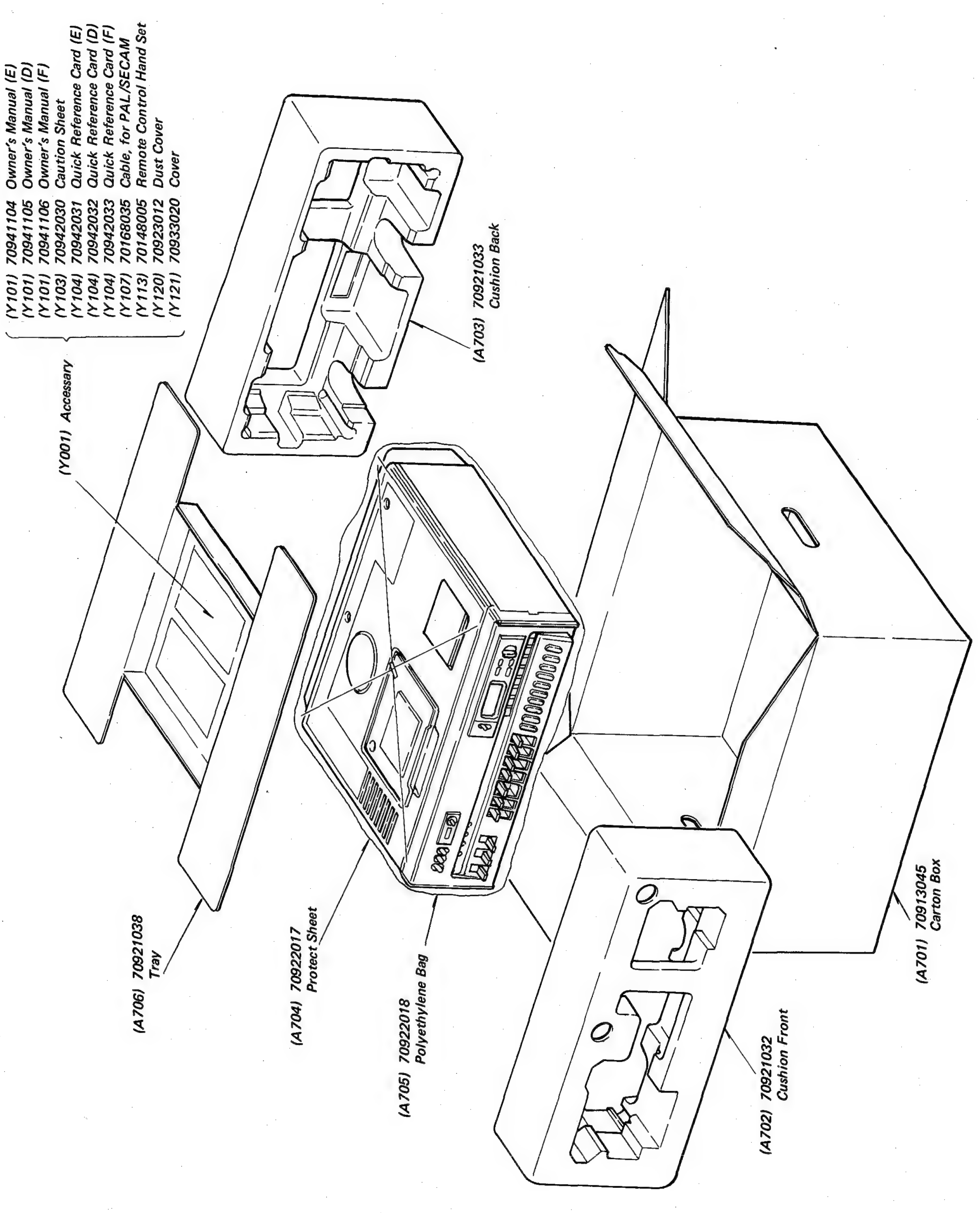
(9) MAIN BASE ASSEMBLY



(10) CYLINDER ASSEMBLY



(11) PACKING ASSEMBLY



SECTION 8 PARTS LIST

ELECTRICAL PARTS (V-5470)

ABBREVIATIONS;

Capacitors . . . . . .CD: Ceramic Disk, PF: Plastic Film,
EL: Electrolytic

Resistors . . . . . . .CF: Carbon Film, CC: Carbon Composition,
OMF: Oxide Metal Film, VR: Variable Resistor

(All CD and PF capacitors are ±5%, 50V and all resistors, ±5%, 1/8W unless otherwise noted.)

NOTE: The parts identified by shading and ⚠ mark are critical for safety. Replace only with part number specified.

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CONVERTER BOARD ASSEMBLY PW2087		
CAPACITORS		
CE02,CF05	24636220	EL, 22μF, 50V
CE11,CF07, CF08	24232103	CD, 0.01μF, +80%, -20%, 50V
CF01,CF09	24634101	EL, 100μF, 25V
CF02	24212222	CD, 0.0022μF, ±10%, 50V
CF03	24212681	CD, 680pF, ±10%, 50V
CF04	24641100	EL, 10μF, 100V
RESISTORS		
RF01	24360104	CF, 100K ohm
RE01	24982829	MF, 8.2 ohm, 1/2W
RF02	24360331	CF, 330 ohm
COIL AND TRANSFORMER		
LF01	23283560	Coil, TRF4560, Peaking
TF01	23213356	Trans, TPW3015, Converter
SEMICONDUCTORS		
QF01	A6317540	NPN, Transistor, 2SC1815-Y
QF02	A6716560	NPN, Transistor, 2SC495-Y
DF01,DF02	23115888	Zener Diode, RU1A
DF03	70115067	Zener Diode, RD36EB3
SELECTOR BOARD ASSEMBLY PW2139		
CAPACITORS		
C001,C002, C003,C004, C098,C009, C011,C012, C021,C022, C024,CA03, CA04,CA05, CA14,CA15, CB05,CC05, CC06,CC07, CE05,CE06, CE08,CE09, CE10,CF06	24232103	CD, 0.01μF, +80%, −20%, 50V
C005,C013, C014	24232102	CD, 0.001μF, +80%, −20%, 50V
C006,CB06, CB08	24617999	EL, 0.47μF, ±10%, 50V
C007,CA09	24633470	EL, 47μF, 16V
C016,C017	24436020	CD, 2pF
C018	24436150	CD, 15pF
C019,C020	24436470	CD, 47pF
C025,CE07	24636229	EL, 2.2μF, 50V
C026	24692752	PF, 0.075μF
C023,CE04	24633101	EL, 100μF, 16V
C027	24633100	EL, 10μF, 16V
C030	24633471	EL, 470μF, 16V
C031	24436010	CD, 1pF, ±50%
C032	24356680	CD, 68pF
C033	24340100	CD, 10pF
C034	24436560	CD, 56pF
C035	24634470	EL, 47μF, 25V
CA01	24602472	PF, 0.0047μF, ±10%, 50V
CA06,CA07	24340121	CD, 120pF
CA08	24636010	EL, 1μF, 50V

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CB01	24085031	EL, 1μF, 25V, NON Polar
CB02,CB03	24436330	CD, 33pF
CB04	24636229	EL, 2.2μF, 50V
CB07	24602154	PF, 0.15μF, ±10%, 50V
CB09,CB10	24580001	Tantal Solid, 6.8μF, ±20%, 35V
CB11	24692473	PF, 0.047μF
CB12	24602124	PF, 0.12μF, ±10%, 50V
CC01	24602104	PF, 0.1μF, ±10%, 50V
CC02	24602333	PF, 0.033μF, ±10%, 50V
CC03	24635100	EL, 10μF, 35V
CC04	24636220	EL, 22μF, 50V
CE03	24636101	EL, 100μF, 50V
RESISTORS		
R001	24360101	CF, 100 ohm
R002	24360562	CF, 5.6K ohm
R003,R010, R015,R016, R023,RB01, RB03	24360102	CF, 1K ohm
R004,RA01, R011	24360221	CF, 220 ohm
R005	24360471	CF, 470 ohm
R006	24360270	CF, 27 ohm
R007	24360182	CF, 1.8K ohm
R008	24360824	CF, 820K ohm
R025	24360271	CF, 270 ohm
R012,R013	24360122	CF, 1.2K ohm
R014	24360392	CF, 3.9K ohm
R017	24360153	CF, 15K ohm
R018	24360473	CF, 47K ohm
R027	24360152	CF, 1.5K ohm
R020	24360222	CF, 2.2K ohm
R024	24360242	CF, 2.4K ohm
R026,RA02, RA06,RB05, RB06,RB07	24360103	CF, 10K ohm
R028,	24360242	CF, 2.4K ohm
R029	24360202	CF, 2K ohm
R030	24941821	CC, 820 ohm, ±5%, ¼W
R051	24061953	VR, 5K ohm, ½W
R052	24061254	VR, 330K ohm, ±5%, 1W
R091	24963680	OMF, 68 ohm, ±5%, 1W
R092	24963221	OMF, 220 ohm, 1W
RA03,RA04	24360183	CF, 18K ohm
RA05	26360224	CF, 220K ohm
RB02,RB04	24360433	CF, 43K ohm
RB08,RB10, RB12,RB29	24360104	CF, 100K ohm
RB09,RB11, RB21	24360512	CF, 5.1K ohm
RB13	24360623	CF, 62K ohm
RB14	24360163	CF, 16K ohm
RB15	24360223	CF, 22K ohm
RB16,RB22	24360682	CF, 6.8K ohm
RB17	24360113	CF, 11K ohm
RB18,RB20	24360273	CF, 27K ohm
RB19	24360123	CF, 12K ohm
RB23	24360432	CF, 4.3K ohm
RB28	24941685	CF, 6.8M ohm, 1/2W

LOCATION NUMBER	PART NUMBER	DESCRIPTION
RB30	24360513	CF, 51K ohm
RB31	24360183	CF, 18K ohm
RE02	24962102	OMF, 1K ohm, ½W
RE03	24962152	OMF, 1.5K ohm, ½W
RE04	24962183	OMF, 18K ohm, ½W
RE05	24963132	OMF, 1.3K ohm, 1W
RE06	24360622	CF, 6.2K ohm
RE07	24962332	OMF, 3.3K ohm, ½W
RE08	24360363	CF, 36K ohm
RE09	24360154	CF, 150K ohm
COILS		
L001	23261976	Coil, TRF9228, Choke
L002	23221047	TRF9201, Choke
L003	23262880	Coil, TRF1446, PIF
L004,L005	23262881	Coil, TRF1445, AFT
L006	23283120	Coil, TRF4120JG, Peaking
L007	23252198	Coil, TRF6702, SIF
L010	23283309	Coil, TRF4309JG
L011	23283150	Coil, TRF4150J, Peaking
L012	23283180	Coil, TRF4180JG, Peaking
LA01	23283220	Coil, TRF4220J, Peaking
LA02	23261034	Coil, AZ9146E, Choke
LF02	23261026	Coil, AZ9004S, Choke
SEMICONDUCTORS		
Q001	A6708850	NPN, Transistor, 2SC388
Q004,Q005, QB01,QB02, QB03,QB06	A6534040	PNP, Transistor, 2SA1015-Y
QB04,QB05	A6708300	NPN, Transistor, 2SC383
QB07,QB08, QB09	A6317540	NPN, Transistor, 2SC1815-Y
QE01	A6319500	NPN, Transistor, 2SC2073
QE02	A6532300	PNP, Transistor, 2SA940
IC002	B0354700	IC, TA7607AP, PIF, AFT
IC003	B0316451	IC, TA7176A, FA-1
ICA01	B0410020	IC, TC9002AP, LSI
ICB10	B0324700	IC, TA7315P
ICC01	B0428410	IC, TMM841P
ICC02	B0355800	IC, TA7619AP
DA01,DB01, DB02,DB03, DB04,DB05, DB06,DE02	A7246700	Diode, 1S1555
DE01	23115878	Diode, μPC574JC
MISCELLANEOUS		
Q002,QC02	23116947	IC Socket, 16P
QA01	23116843	IC Socket, 42P
QC01	23116948	IC Socket, 14P
Z001	23107992	Filter, F1024, PIF
Z002	23107008	Celamic Filter, 5.5MHz
Z004	23107972	Celamic Filter, 5.5MHz
ZA01	24000926	Resistor Block, 47K ohm, ±20%
ZA02	24000925	Resistor Block, 100 ohm, 1/8W
ZA03	24000944	Resistor Block, 100 ohm, 1/8W
ZA04	24000924	Resistor Block, 12K ohm, 1/8W
ZA05	24000939	Resistor Block, 12K ohm, 1/8W
ZA06,ZA07	24094578	Capacitor Block, 0.01μF, 50V
PA01	23164794	Plug, 14P
PA02	23164790	Plug, 10P
PE08,P006	23164784	Plug, 4P
PB03	23164787	Plug, 7P
PB04	23163162	Phono Jack

SETTING BOARD ASSEMBLY PW2187

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CAPACITOR		
CA02	24692393	PF, 0.039μF
RESISTORS		
RA07	24360122	CF, 1.2K ohm
RA08	24941132	CF, 1.3K ohm
RA09	24360102	CF, 1K ohm
RA51	24060764	VR, 100K ohm, 1/10W
SEMICONDUCTORS		
DA02	A8600045	LED, TLR102C
DA03,DA34, DA35	A7246700	Diode, 1S1555
MISCELLANEOUS		
SA01,SA02	23145845	Switch, 2C2P
SA03	23145887	Push Switch, 1C1P

AUDIO BOARD ASSEMBLY PW2108

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CAPACITORS		
C101,C102, C104,C105, C106,C111, C119,C123, C125,C126, C128,C129	24232223	CD, 0.022μF, +80%, -20%, 50V
C103,C108, C112,C120, C704,C710, C719,C734	24633100	EL, 10μF, 16V
C134	24633101	EL, 100μF, 16V
C107,C127, C131,C703, C722,C723, C726,C733	24633470	EL, 47μF, 16V
C109,C110, C117,C121, C132	24232103	CD, 0.01μF, +80%, -20%, 50V
C113,C114	24436680	CD, 68pF
C115,C122	24436101	CD, 100pF
C116	24633220	EL, 22μF, 16V
C118	24436471	CD, 470pF
C124	24436331	CD, 330pF
C130	24867562	PF, 0.0056μF
C151,C152	24093997	Trimer, 22.5pF, 250V
C701	24212821	CD, 820pF, ±10%, 50V
C702,C706, C709,C712, C715,C732	24635479	EL, 4.7μF, 35V
C705	24867223	PF, 0.022μF
C707,C717	24212102	CD, 0.001μF, ±10%, 50V
C708	24867682	PF, 0.0068μF
C711	24636010	EL, 1μF, 50V
C713	24212681	CD, 680PF
C714	24436241	CD, 240pF
C716	24436470	CD, 47pF
C718	24631221	EL, 220μF, 6.3V
C720	24867102	PF, 0.001μF
C721,C724, C725	24633220	EL, 22μF, 16V
C727	24212472	CD, 0.0047μF, ±10% 50V
C728	24867153	PF, 0.015μF
C729	24214221	CD, 220pF, ±10%, 500V
C730	24867333	PF, 0.033μF
C731	24867753	PF, 0.075μF

LOCATION NUMBER	PART NUMBER	DESCRIPTION
C735	24692153	PF, 0.015μF
C736	24692333	PF, 0.033μF
RESISTORS		
R101,R102	24360153	CF, 15K ohm
R103,R109, R121,R122, R133,R136, R128,R718, R721	24360681	CF, 680 ohm
R104,R127, R137,R149, R141,R703	24360102	CF, 1K ohm
R105,R129	24360332	CF, 3.3K ohm
R106,R111 R114,R115	24360330	CF, 33 ohm
R107,R132	24360471	CF, 470 ohm
R108	24360150	CF, 15 ohm
R110,R123, R124,R125, R126,R139	24360222	CF, 2.2K ohm
R112,R116, R117,R140	24360331	CF, 330 ohm
⚠R113,R120	24531100	Fusible, 10 ohm, 1/2W
R118,R119, R701	24360100	CF, 10 ohm
R144,R702, R705,R708, R714,R717, R725,R736	24360103	CF, 10K ohm
R131	24941221	CF, 220 ohm ¼W
R134	24360391	CF, 390 ohm
R135	24360333	CF, 33K ohm
R138	24360562	CF, 5.6K ohm
R130,R142, R143,R732	24360101	CF, 100 ohm
R145	24360689	CF, 6.8 ohm
R146,R711	24360273	CF, 27K ohm
R148,R723, R724,R737, R740	24360682	CF, 6.8K ohm
R151	24061316	VR, 470 ohm 0.15W
R152,R153	24061328	VR, 47K ohm, 0.15W
R154,R155	24061320	VR, 2.2K ohm, 0.15W
R156,R752	24061322	VR,4.7K ohm, 0.15W
R704,R735	24360104	CF, 100K ohm
R706, R707	24360152	CF, 1.5K ohm
R710,R719 R738	24360223	CF, 22K ohm
R712,R715, R722,R726, R727,R728, R729,R730, R739,R741	24360472	CF, 4.7K ohm
R713,R716, R733	24360473	CF, 47K ohm
R720	24360105	CF, 1M ohm
R731	24941229	CF, 2.2 ohm, ¼W
⚠R734	24556479	Fusible, 4.7 ohm, ±10%, 1/2W
R751	24061326	VR, 22K ohm, 0.15W
R753	24061334	VR, 470K ohm, 0.15W
COILS AND TRANSFORMERS		
L101,L112	23283100	Coil, TRF4100J, Peaking
L102,L114	23283152	Coil, TRF4152J, Peaking
L103,L104, L113	23283102	Coil, TRF4102J, Peaking

LOCATION NUMBER	PART NUMBER	DESCRIPTION
L105,L703	23283221	Coil, TRF4221J, Peaking
L106,L107 L702	23283822	Coil, TRF4822J, Peaking
L108,L109	23283330	Coil, TRF4330J, Peaking
L110	23283121	Coil, TRF4121J, Peaking
L111	23283479	Coil, TRF4479J, Peaking
L701	23221987	Coil, CSL1213, Choke
T101	23254992	Trans, TRF7001
T102,T103	23254983	Trans, TRF7006
T701	23254984	Trans, TRF7005
SEMICONDUCTORS		
Q104,Q105	70114087	FET, 2SK43-3
Q104,Q105	70114088	FET, 2SK43-4
Q101,Q106, Q107,Q703, Q704,Q705, Q709	A6317540	NPN, Transistor, 2SC1815-Y
Q102	A6314340	NPN, Transistor, 2SC1626-Y
Q103,Q706, Q707	A6319340	NPN, Transistor, 2SC1959-Y
Q708	A6041880	FET, 2SK117-BL
IC108	70119048	IC, CX-134A, DOC
IC701	70119023	IC, AN262, Audio
IC702	B0311006	IC, TA7120P-B, Audio
	or B0311007	IC, TA7120P-C, Audio
	or B0311008	IC, TA7120P-D, Audio
D101,D102, D701,D702	A7246700	Diode, 1S1555
MISCELLANEOUS		
X101	70153020	Delay Line, ADL-CL55
S101	23145839	Slide Switch, 6C2P
S701	23145840	Slide Switch, 4C2P
P101	23164790	Plug, 10P
P102	23164788	Plug, 8P
P103	23164787	Plug, 7P
P104	23162043	Terminal Flat
P701	23164784	Plug, 4P
P702	23164783	Plug, 3P
P703	23164786	Plug, 6P
P704	23164785	Plug, 5P

VIDEO BOARD ASSEMBLY PW2109

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CAPACITORS		
C201	24436241	CD, 240pF
C202,C217, C448	24436560	CD, 56pF
C203,C236, C315,C320	24436101	CD, 100pF
C204,C220, C221,C224, C225,C227, C228,C231, C232,C242, C245,C246, C247,C249, C260,C261, C262,C264, C265,C266, C269,C270, C280,C286, C297,C304, C311,C317, C403,C422, C438,C476,	24232103	CD, 0.01μF, +80%, -20%, 50V

LOCATION NUMBER	PART NUMBER	DESCRIPTION
C205,C214, C263,C275	24633100	EL, 10μF, 16V
C206,C207, C209,C213, C222,C226, C234,C238, C248,C282, C292,C301, C303,C316, C412,C414, C419,C420, C424,C432, C442,C473	24232223	CD, 0.022μF, +80%, -20%, 50V
C208,C235, C240,C281, C291,C302, C318,C415, C443,C474, C475,C479,	24633470	EL, 47μF, 16V
C210,C211, C216,C274 C287,C408	24635479	EL, 4.7μF, 35V
C212,C215, C229	24867473	PF, 0.047μF
C233,C239, C278,C288, C294,C305, C307	24636010	EL, 1μF, 50V
C218,C283, C284,C407	24436471	CD, 470pF
C219,C268, C439	24436151	CD, 150pF
C223	24636229	EL, 2.2μF
C230,C298	24436121	CD, 120pF
C237,C314, C418	24436331	CD, 330pF
C241,C433	24436330	CD, 33pF
C243,C244, C285,C431, C441	24436271	CD, 270pF
C272,C273	24867152	PF, 0.0015μF
C276,C313	24212681	CD, 680pF, ±10%, 50V
C279	24212331	CD, 330pF, ±10%, 50V
C271,C277, C289	24436221	CD, 220pF
C290	24867472	PF, 0.0047μF
C293	24212472	CD, 0.0047μF, ±10%, 50V
C295,C312, C409	24212102	CD, 0.001μF, ±10%, 50V
C296	24353270	CD, 27pF
C299,C300	24436270	CD, 27pF
C306,C308	24867123	PF, 0.012μF
C309	24353160	CD, 16pF
C310	24353470	CD, 47pF
C319	24436200	CD, 20pF
C401,C429, C437,C440 C460,C461 C435	24632101	EL, 100μF, 10V
C402	24633330	EL, 33μF, 16V
C404	70412005	Tantal, 0.22pF
C405	24867223	PF, 0.022μF
C406,C466	24632220	EL, 22μF, 10V
C410	24867104	PF, 0.1μF
C411,C445	24436821	CD, 820pF
C413,C446	24436181	CD, 180pF
C416	24359181	CD, 180pF

LOCATION NUMBER	PART NUMBER	DESCRIPTION
C430	24632221	EL, 220μF, 10V
C434	24632102	EL, 1000μF, 10V
C436	24632470	EL, 47μF, 10V
C444	24436390	CD, 39pF
C447,C635	24212222	CD, 0.0022μF, ±10%, 50V
C449	24436820	CD, 82pF
C462	24353111	CD, 110pF
C463,C464, C465	24436511	CD, 510pF
C467	24436300	CD, 30pF
C477	24633220	EL, 22μF, 16V
C478	24436470	CD, 47pF
C636,C640	24636478	EL, 0.47μF
C637	24212471	CD, 470pF, ±10%, 50V
C638,C639	24867103	PF, 0.01μF
RESISTORS		
R201,R361	24380112	CF, 1.1K ohm
R202,R203, R206,R225, R228,R231, R279,R338, R377,R386, R390,R401, R407,R408, R410,R424, R439,R474, R491,R364, R667	24360102	CF, 1K ohm
R204,R205, R207,R208, R223,R224, R226,R344	24360473	CF, 47K ohm
R209,R211, R212,R213, R214,R487, R490	24360223	CF, 22K ohm
R215	24360224	CF, 220K ohm
R210,R273, R416,R670, R671,R674	24360103	CF, 10K ohm
R216	24360273	CF, 27K ohm
R217,R340	24380562	CF, 5.6K ohm
R218,R417, R418	24380333	CF, 33K ohm
R219,R268, R341	24360221	CF, 220 ohm
R220,R233, R405,R406, R414	24360472	CF, 4.7K ohm
R221	24380104	CF, 100K ohm
R222,R276, R331,R336	24380563	CF, 56K ohm
R227,R346, R415,R344	24380473	CF, 47K ohm
R229	24380303	CF, 30K ohm
R230,R299	24380183	CF, 18K ohm
R313,R318, R323,R499	24380472	CF, 4.7K ohm
R236,R237, R238,R239	24360391	CF, 390 ohm
R235,R263, R275,R421, R432,R443	24360222	CF, 2.2K ohm
R234,R241, R261,R270	24380391	CF, 390 ohm
R242,R337	24380681	CF, 680 ohm
R243	24360511	CF, 510 ohm

LOCATION NUMBER	PART NUMBER	DESCRIPTION
R244	24360562	CF, 5.6K ohm
R385,R673	24360432	CF, 4.3K ohm
R246,R305, R382,R388, R465	24360332	CF, 3.3K ohm
R247,R249, R286,R306, R489	24380222	CF, 2.2K ohm
R248	24380511	CF, 510 ohm
R251	24061247	VR, 22K ohm, 0.15W
R252,R351	24061245	VR, 10K ohm, 0.15W
R253	24061237	VR, 470 ohm, 0.15W
R254,R255, R353,R451	24061241	VR, 2.2K ohm, 0.15W
R256	24061240	VR, 1.5K ohm, 0.15W
R257,R350, R354	24061239	VR, 1K ohm,0.15W
R258	24061255	VR, 470K ohm, 0.15W
R260,R329, R430	24380821	CF, 820 ohm
R262,R301, R307,R334	24380332	CF, 3.3K ohm
R264,R265, R278,R485	24380331	CF, 330 ohm
R266,R378, R379	24380133	CF, 13K ohm
R281,R436, R494,R365	24380152	CF, 1.5K ohm
R434,R368	24360151	CF, 150 ohm
R269,R287, R298,R442	24380471	CF, 470 ohm
R271	24360560	CF, 56 ohm
R272,R302, R304,R322, R349	24380153	CF, 15K ohm
R274,R288, R294,R321, R325,R330, R376,R403, R445,R460	24380102	CF, 1K ohm
R277,R282, R290,R291, R293,R314, R320,R332, R335,R375, R396,R404, R413	24380103	CF, 10K ohm
R280,R467	24380122	CF, 1.2K ohm
R232,R283, R486,	24380223	CF, 22K ohm
R284	24380751	CF, 750 ohm
R285,R441	24360563	CF, 56K ohm
R289,R367, R435	24360271	CF, 270 ohm
R292	24380123	CF, 12K ohm
R295,R472	24380752	CF, 7.5K ohm
R297	24380154	CF, 150K ohm
R300	24360683	CF, 68K ohm
R303,R308, R311,R339, R373	24380682	CF, 6.8K ohm
R309,R398, R428	24360153	CF, 15K ohm
R296,R310, R473	24360752	CF, 7.5K ohm
R312,R326, R444	24380101	CF, 100 ohm

LOCATION NUMBER	PART NUMBER	DESCRIPTION
R315	24380512	CF, 5.1K ohm
R316,R370, R371,R477	24380182	CF, 1.8K ohm
R317	24380224	CF, 220K ohm
R319	24360333	CF, 33K ohm
R324	24360471	CF, 470 ohm
R327	24380622	CF, 6.2K ohm
R328	24380393	CF, 39K ohm
R333,R462	24380822	CF, 8.2K ohm
R342	24360681	CF, 680 ohm
R343,R419	24360912	CF, 9.1K ohm
R345,R387	24360101	CF, 100 ohm
R347,R395, R447	24360561	CF, 560 ohm
R348,R425	24360272	CF, 2.7K ohm
R352	24061137	VR, 3.3K ohm, 0.15W
R358	24061242	VR, 3.3K ohm, 0.15W
R355	24061243	VR, 4.7K ohm, 0.15W
R356	24061134	VR, 1K ohm, 0.15W
R357	24061136	VR, 2.2K ohm, 0.15W
R359	24061140	VR, 10K ohm, 0.15W
R360	24380683	CF, 68K ohm
R362,R363	24360162	CF, 1.6K ohm
R240,R267, R391,R464	24360152	CF, 1.5K ohm
R364,R493	24360122	CF, 1.2K ohm
R366	24360303	CF, 30K ohm
R368	24380151	CF, 150 ohm
R369,R380, R495	24360821	CF, 6.8K ohm
R372	24360821	CF, 820 ohm
R374,R669	24360512	CF, 5.1K ohm
R381,R438, R463,R479	24360202	CF, 2K ohm
R383,R480	24360622	CF, 6.2K ohm
R389	24380681	CF, 680 ohm
R392	24380302	CF, 3K ohm
R393	24380301	CF, 300 ohm
R397	24360472	CF, 4.7K ohm
R402	24360112	CF, 1.1K ohm
R448,R394	24380561	CF, 560 ohm
R409	24380750	CF, 75 ohm
R411	24380121	CF, 120 ohm
R412	24360121	CF, 120 ohm
R420,R437	24360182	CF, 1.8K ohm
R422	24360132	CF, 1.3K ohm
R423	24360221	CF, 220 ohm
R426,R446	24360331	CF, 330 ohm
R427	24380161	CF, 160 ohm
R429	24380273	CF, 27K ohm
R431	24360393	CF, 39K ohm
R433,R488	24360391	CF, 390 ohm
R440,R483	24360100	CF, 10 ohm
R449	24380222	CF, 2.2K ohm
R461	24380243	CF, 24K ohm
R466	24360392	CF, 3.9K ohm
R468	24360824	CF, 820K ohm
R469	24360243	CF, 24K ohm
R470	24360822	CF, 8.2K ohm
R471	24360183	CF, 18K ohm
R475,R476	24380202	CF, 2K ohm
R384,R478	24360302	CF, 3K ohm
R245,R481, R497	24380432	CF, 4.3K ohm
R482	24380623	CF, 62K ohm
R484	24360161	CF, 160 ohm

LOCATION NUMBER	PART NUMBER	DESCRIPTION
R492	24000952	Thermistor, R302K
R497	24380432	CF, 4.3K ohm
R496	24380912	CF, 9.1K ohm
R498	24380242	CF, 2.4K ohm
R668	24360624	CF, 620K ohm
R672	24360684	CF, 680K ohm
COILS AND TRANSFORMERS		
L201,L217, L304	23283121	Coil, TRF4121J, Peaking
L202	23283689	Coil, TRF4689JG, Peaking
L203,L207, L310	23283829	Coil, TRF4829J, Peaking
L204,L218	23283680	Coil, TRF4680JG, Peaking
L205,L206, L208,L211, L216,L219, L311	23283471	Coil, TRF4471JG, Peaking
L209	23283620	Coil, TRF4620JG, Peaking
L215	23283470	Coil, TRF4470JG, Peaking
L210	23283472	Coil, TRF4472JG, Peaking
L212,L214	23283102	Coil, TRF4102J, Peaking
L213	23283270	Coil, TRF4270JG, Peaking
L251,L252	23252197	Trans, TRF6906
L301,L308	23283180	Coil, TRF4180J, Peaking
L302,L303, L306	23283151	Coil, TRF4151J, Peaking
L305	23283479	Coil, TRF4479J, Peaking
L307	23283330	Coil, TRF4330J, Peaking
L309	23283820	Coil, TRF4820J, Peaking
T201	23254988	Trans, TRF7031
T251	23254987	Trans, TRF7033
T252	23252966	Coil, TRF7038, OSC
T253	23252967	Coil, TRF7037, OSC
T351	23252988	Trans, TRF7023
SEMICONDUCTORS		
IC201	70119037	IC, CX-136A, Color Process
IC202,IC203	70119066	IC, CX-130, Switching
IC204,IC205	70119040	IC, CX-150, Burst ID
IC206,IC207	70119038	IC, CX-137A, Color Sync.
IC208	70119039	IC, CX-145, F/44 Counter
IC209	70119106	IC, SN74LS00N
IC210,IC212	70119067	IC, SN74LS93N
IC211	70119071	IC, SN74LS74AN
Q213,Q214, Q215,Q216, Q217,Q218, Q219,Q220, Q221,Q222, Q223,Q224, Q225,Q226, Q228,Q229, Q230,Q231, Q235,Q237, Q238,Q239, Q407,Q408, Q409,Q410, Q411,Q412, Q413,Q414, Q416,Q419, Q422,Q423, Q424,Q425, Q428,Q430, Q633	A6317540	NPN, Transistor, 2SC1815-Y
Q232,Q233, Q234,Q236,		

LOCATION NUMBER	PART NUMBER	DESCRIPTION
Q404,Q405, Q406,Q415, Q420,Q421, Q426,Q427, Q429,Q632	A6534040	PNP, Transistor, 2SA1015-Y
IC401	B0356320	IC, TA7637P
IC402	B0356300	IC, TA7636P
IC403	B0470693	IC, TC4069BP
Q431	A6319340	NPN, Transistor, 2SC1959Y
D201,D202, D203,D204, D205,D206, D208,D209, D401,D402, D404,D405, D406,D407, D408,D409, D413,D414, D415,D416, D417,D635	A7246700	Diode, 1S1555
D207	A7285900	Zener Diode, 02Z5.6A
MISCELLANEOUS		
X201	23153979	X'tal, 4.43 MHz, Carrier
X202	23153980	X'tal, 4.43 MHz, APC
X203	70153021	Delay Line, ADL-CF544T
X204	23153996	Delay Line, 1H Delay Line, PAL
	or 23153990	Delay Line, 1H Delay Line, PAL
Z201	70132030	LC Filter, LC730D
Z202	70132031	LC Filter, LC854
Z203	70153022	Ceramic Filter, SFE5.12MB
Z301	70132032	LC Filter, LC802A
Z302	70132034	Delay Line, 601D-144
Z303	70132037	Delay Line, 401D-141
Z304	70132032	LC Block, LC660A LPF
P201	23164758	Plug, 8P
P202	23164757	Plug, 7P
P203	23164756	Plug, 6P
P204	23164755	Plug, 5P

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LOCATION NUMBER	PART NUMBER	DESCRIPTION
CAPACITORS		
C503,C508, C535,C602, C605,C625, C627	24633220	EL, 22μF, 16V
C504,C616	24636478	EL, 0.47μF
C505	24212681	CD, 680pF, ±10%, 50V
C506	24631221	EL, 220μF, 6.3V
C507,C532, C542,C603, C604	24633470	EL, 47μF, 16V
C509	24692474	PF, 0.47μF
C510	24692102	PF, 0.001μF
C511,C513, C538,C541, C543,C544, C545,C631	24232103	CD, 0.01μF, +80%, -20%, 50V
C512,C514, C519,C608, C609,C612, C613,C618, C622	24636010	EL, 1μF, 50V
C515,C606	24632101	EL, 100μF, 10V
C516,C517	24692272	PF, 0.0027μF
C518	24867333	PF, 0.033μF

LOCATION NUMBER	PART NUMBER	DESCRIPTION
C522	24692392	PF, 0.0039µF
C524,C526, C530,C533, C610	24633100	EL, 10µF, 16V
C525,C527, C529,C531, C617	24692104	PF, 0.1µF
C537	24085023	EL, 10µF, 16V
C528	24636339	EL, 3.3µF
C534,C546, C611,C628	24692473	PF, 0.047µF
C540	24634470	EL, 47µF, 25V
C607,C626	24692103	PF, 0.01µF
C619	24636229	EL, 2.2µF, 50V
C620,C621, C629,C632, C633	24635479	EL, 4.7µF, 35V
C623,C624	24692332	PF, 0.0033µF
C630	24212681	CD, 680pF, ±10%, 50V
RESISTORS		
R505,R615, R631	24380392	CF, 3.9K ohm
R506,R511, R569,R570, R617,R650	24380472	CF, 4.7K ohm
R507,R524, R530,R532, R534,R590, R611,R620, R626,R628, R629,R638, R643,R644, R647,R649, R681	24380103	CF, 10K ohm
R508,R509	24360563	CF, 56K ohm
R510	24380821	CF, 820 ohm
R512,R518, R523,R578, R579,R610, R621,R622, R664	24380223	CF, 22K ohm
R513,R533, R683	24380102	CF, 1K ohm
R514,R515, R521,R522, R577,R580, R583,R612, R642	24380222	CF, 2.2K ohm
R516	24380334	CF, 330K ohm
R517,R536	24380105	CF, 1M ohm
R519	24380133	CF, 13K ohm
R520	24380124	CF, 120K ohm
R527,R547, R645	24380123	CF, 12K ohm
R526,R564, R575,R576, R606,R608, R609	24360103	CF, 10K ohm
R525,R528, R601	24360222	CF, 2.2K ohm
R529,R531, R618,R619	24380154	CF, 150K ohm
R535,R686	24360393	CF, 39K ohm
R538,R541, R542,R550, R607	24380393	CF, 39K ohm

LOCATION NUMBER	PART NUMBER	DESCRIPTION
R539,R544, R563,R589, R632,R633, R640,R666, R691,R695	24380104	CF, 100K ohm
R540	24380822	CF, 8.2K ohm
R543	24380183	CF, 18K ohm
R545,R641, R677	24360104	CF, 100K ohm
R546,R648, R661,R663, R665	24380473	CF, 47K ohm
R548,R571, R572,R574, R613,R684, R687,R694	24380562	CF, 5.6K ohm
R549	24360123	CF, 12K ohm
R551,R552, R651	24061255	VR, 470K ohm, 0.15W
R553	24061257	VR, 1M ohm, 0.15W
R554,R652, R653	24061247	VR, 22K ohm, 0.15W
R561	24380629	CF, 6.2 ohm
R562	24380331	CF, 330 ohm
R565	24380113	CF, 11K ohm
R566	24380183	CF, 18K ohm
R568	24380684	CF, 680K ohm
R573	24380474	CF, 470K ohm
R581	24360102	CF, 1K ohm
R582,R602, R625	24360562	CF, 5.6K ohm
R584	24380272	CF, 2.7K ohm
R585	24380152	CF, 1.5K ohm
R586	24360101	CF, 100 ohm
R587,R630, R679	24360473	CF, 47K ohm
R588	24380181	CF, 180 ohm
R604	24380820	CF, 82 ohm
R605,R614	24360822	CF, 8.2K ohm
R616	24360223	CF, 22K ohm
R623,R624	24380224	CF, 220K ohm
R634,R639, R646	24360682	CF, 6.8K ohm
R636	24360472	CF, 4.7K ohm
R637	24380163	CF, 16K ohm
R662	24360471	CF, 470 ohm
R678	24380431	CF, 430 ohm
R680	24380332	CF, 3.3K ohm
R682	24380221	CF, 220 ohm
R685	24380561	CF, 560 ohm
R689	24360432	CF, 4.3K ohm
R690	24360272	CF, 2.7K ohm
R692	24380432	CF, 4.3K ohm
R693	24380242	CF, 2.4K ohm
SEMICONDUCTORS		
IC501	B0430800	IC, TM4216P
IC502	B0311009	IC, TA7120P-E
	or B0311008	IC, TA7120P-D
	or B0311007	IC, TA7120P-C
IC503	B0351500	IC, TA75902P, Amp
Q506,Q507, Q509,Q510, Q512,Q513, Q514,Q515, Q517,Q521, Q522,Q602,		

LOCATION NUMBER	PART NUMBER	DESCRIPTION
Q603,Q604, Q605,Q606, Q607,Q608, Q609,Q610, Q612,Q617, Q618,Q620, Q621,Q623, Q624,Q630, Q631	A6317540	NPN, Transistor, 2SC1815-Y
Q508,Q511, Q516,Q518, Q619,Q625	A6534040	PNP, Transistor, 2SA1015A
Q519	A6823560	NPN, Transistor, 2SD235-Y
Q520	A6502460	PNP, Transistor, 2SA496-Y
Q523	A6319340	NPN, Transistor, 2SC1959-Y
IC601	70119049	IC, CX-141, Logic
Q626,Q627, Q628,Q629	A6716660	NPN, Transistor, 2SC496-Y
D501,D503, D506,D507, D508,D509, D510,D513 D601,D602, D603,D605, D606,D607, D608,D609, D610,D611, D612,D613, D614,D615, D616,D617, D618,D619, D620,D621, D622,D623, D624,D625, D626,D627, D628,D630	A7246700	Diode, 1S1555
D505,D511, D512,D629	A7285900	Zener Diode, 02Z-5.6A
MISCELLANEOUS		
P501,P504, P506,P510, P511,P601, P604,P605, P607	23164783	Plug, 3P
P505	23164787	Plug, 7P
P502,P507	23164784	Plug, 4P
P503,P509	23164786	Plug, 6P
P508	23164785	Plug, 5P
P606,P608	23164792	Plug, 12P

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LOCATION NUMBER	PART NUMBER	DESCRIPTION
CAPACITORS		
⚠ C801	24098011	MP, 0.1μF, ±20%, AC250V
⚠ C802	24086997	EL, 3300μF, 35V
C804,C807, C808	24232103	CD, 0.01μF, +80%, -20%, 50V
C805	24615102	EL, 1000μF, ±10%, 35V
C806,C809	24634330	EL, 33μF, 25V
C810	24635479	EL, 4.7μF, 35V
C811	24633100	EL, 10μF, 16V
C812	24633470	EL, 47μF, 16V
C815	24636478	EL, 0.47μF
C816,C817, C818	24232473	CD, 0.047μF, +80% −20%, 50V
RESISTORS		
R801,R802, R809	24360102	CF, 1K ohm
R803,R804, R813	24360152	CF, 1.5K ohm
R805,R806	24360123	CF, 12K ohm
R807	24963152	MF, 1.5K ohm, ±5% 1W
R808	24360471	CF, 470 ohm
R810	24360182	CF, 1.8K ohm
R811,R815	24360202	CF, 2K ohm
R812	24360122	CF, 1.2K ohm
R814	24360183	CF, 18K ohm
R816	24360103	CF, 10K ohm
R817	24360223	CF, 22K ohm
R818	24360473	CF, 47K ohm
R851	24061239	VR, 1K ohm, 0.15W
R852	24061237	VR, 470 ohm, 0.15W
TRANSFORMER		
⚠ T801	23111984	Line Filter, TRF3015
SEMICONDUCTORS		
Q802,Q805	A6319340	NPN, Transistor, 2SC1959-Y
Q803,Q806, Q807,Q809	A6317540	NPN, Transistor, 2SC1815-Y
Q804,Q808	A6848520	NPN, Transistor, 2SD880-Y
⚠ D801	A7950540	Diode, S5151
⚠ D802	A7950545	Diode, S5151R
D803,D808	A7286100	Zener Diode, 02Z-6.2A
⚠ D804,D805, ⚠ D806,D807	A7568500	Diode, 1S1885
D809	A7110450	Zener Diode, 05Z13L
D810,D812	A7246700	Diode, 1S1555
MISCELLANEOUS		
⚠ F801	23144125	Fuse, 0.5A
F801A,F802A, F803A	23165102	Fuse Holder
⚠ F802	23144959	Fuse, 3.15A
⚠ F803	23144127	Fuse, 1A
P801	23164784	Plug, 4P
P802	23164789	Plug, 9P
P803	23164790	Plug, 10P
P804	23164787	Plug, 7P
P805,P807	23164783	Plug, 3P
P806	23164786	Plug, 6P

TIMER BOARD ASSEMBLY PW2112

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CAPACITORS		
C861,C862	70412006	TANTAL, 0.33μF, 35V
C864	24353330	CD, 33pF
C865	24093995	Variable Capacitor, 4pF-34pF, 250V
C866	24636010	EL, 1μF
SEMICONDUCTORS		
IC861	B0480380	IC, TC5038P
D862	A7246700	Diode, 1S1555
MISCELLANEOUS		
X861	70153008	X'tal, 32.768 kHz
S861	23145917	Switch Lever, 2C3P
S862,S863, S864,S865	23145842	Switch, Push 1C2P
S866	23145841	Switch Rotary, 2C6P
P861	23164791	Plug, 11P
P862	23164785	Plug, 5P

LOCATION NUMBER	PART NUMBER	DESCRIPTION
P863	23186002	Janper Lead, 25P
P864	70165021	Rubber Joint
G862,G863	70113010	Fuse Type Lamp
PAUSE BOARD ASSEMBLY PW2113		
CAPACITORS		
C901,C903	24635220	EL, 22μF, 35V
C902	24633100	EL, 10μF, 16V
C904	24232103	CD, 0.01μF, +80%, -20%, 50V
C905	24232223	CD, 0.022μF
RESISTORS		
R901,R913, R919,R923	24360472	CF, 4.7K ohm
R902,R914	24360272	CF, 2.7K ohm
R903,R915	24360222	CF, 2.2K ohm
R904,R916, R926	24360102	CF, 1K ohm
R905,R917, R918,R920	24360332	CF, 3.3K ohm
R906,R912	24360123	CF, 12K ohm
R907,R908, R911	24360223	CF, 22K ohm
R909	24360392	CF, 3.9K ohm
R910	24360152	CF, 1.5K ohm
R921,R922	24360103	CF, 10K ohm
R925	24360104	CF, 100K ohm
R924	24360101	CF, 100 ohm
⚠ R927	24000911	THERMISTOR 1.5 ohm, ±20%
SEMICONDUCTORS		
Q901,Q907	A6502460	PNP, Transistor, 2SA496-Y
Q902	A6610160	PNP, Transistor, 2SB435-Y
Q903,Q909	A6534040	PNP, Transistor, 2SA1015-Y
Q904,Q905, Q906,Q910, Q912,Q913, Q914	A6317540	NPN, Transitor, 2SC1815-Y
Q908	A6623870	PNP, Transistor, 2SB595-Y
Q911	A6841900	NPN, Transistor, 2SD549
D901,D902, D903,D904	A7246700	Diode, 1S1555
⚠ D905	A7568500	Diode, 1S1885
MISCELLANEOUS		
P901	23164793	Plug, 13P
P902	23164783	Plug, 3P
P903	23164791	Plug, 11P
PLUNGER BOARD ASSEMBLY PW2114		
RESISTORS		
R941	24524560	CC, 56 ohm, ±10%, 5W
R942	24524121	CC, 120 ohm, ±10%, 5W
SEMICONDUCTORS		
⚠ D941,D942	A7568500	Diode, 1S1885
MISCELLANEOUS		
P941	23164756	Plug, 6P
DISK DRIVE BOARD ASSEMBLY PW2115		
CAPACITORS		
C961,C962, C963,C964, C965,C968	24232103	CD, 0.01μF, +80%, -20%, 50V
C966,C967	24598471	PF, 470pF
C969	24357200	CD, 20pF
C970,C972, C974	24636010	EL, 1μF, 50V

LOCATION NUMBER	PART NUMBER	DESCRIPTION
C971	24357470	CD, 47pF
C973	24357330	CD, 33pF
RESISTORS		
R961,R967	24380561	CF, 560 ohm
R962	24360101	CF, 100 ohm
R963,R965	24380112	CF, 1.1K ohm
R964	24380102	CF, 1K ohm
R966	24380911	CF, 910 ohm
R968	24380562	CF, 5.6K ohm
R969	24380113	CF, 11K ohm
R970,R971, R972	24380183	CF, 18K ohm
COIL		
L961	70211003	Coil, Choke Trans.
SEMICONDUCTORS		
Q961	A6823560	NPN, Transistor, 2SD235-Y
Q962,Q964, Q965,Q967, Q968	A6317540	NPN, Transistor, 2SC1815-Y
Q963	A6502460	PNP, Transistor, 2SA496-Y
Q966	A6708850	NPN, Transistor, 2SC388A
MISCELLANEOUS		
X961	23153981	X'tal, 5.9725MHz
Z961,Z962	23252969	Coil, TRF7035
P961	23164783	Plug, 3P
P962	23164784	Plug, 4P
P963	23164786	Plug, 6P
SWITCH BOARD ASSEMBLY PW2116		
RESISTORS		
R981	24941471	CC, 470 ohm, ±5%, ¼W
R982	24941681	CC, 680 ohm, ±5%, ¼W
R983,R984	24360103	CF, 10K ohm
R985	24360332	CF, 3.3K ohm
R986	24942112	CC, 1.1K ohm, ±5%, 1/4W
R987	24360752	CF, 7.5K ohm
SEMICONDUCTORS		
Q981	A6534040	PNP, Transistor, 2SA1015-Y
Q982	A6317540	NPN, Transistor, 2SC1815-Y
D981	A8605650	LED, TLG113
D982,D984	A8600600	LED, TLR113
D983	A8607950	LED, TLY113
D985,D987, D988,D989	A7246700	Diode, 1S1555
D990	A7286100	Zener Diode, 02Z6.2A
MISCELLANEOUS		
S981	23145813	Switch, 2C2P
S982,S983	23145812	Switch, 2C2P
S984,S985, S986	23145814	Switch, 2C3P
P981	23164758	Plug, 8P
P982	23164760	Plug, 10P
P983	23164755	Plug, 5P
SPEED CONTROL BOARD ASSEMBLY PW2117		
CAPACITORS		
CH01	24633470	EL, 47μF, 16V
CH02,CH16, CH29	24692103	PF, 0.01μF
CH04	24635479	EL, 4.7μF, 35V

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CH05,CH15, CH22,CH24	24636010	EL, 1μF, 50V
CH06	24692104	PF, 0.1μF
CH07,CH08	24692333	PF, 0.033μF
CH09	24692123	PF, 0.012μF
CH10,CH11, CH21	24692223	PF, 0.022μF
CH12	24692472	PF, 0.0047μF
CH13,CH18, CH23,CH30	24633100	EL, 10μF, 16V
CH14	24633101	EL, 100μF, 16V
CH19,CH20	24436201	CD, 200pF
CH25	24436151	CD, 150pF
CH26	24692332	PF, 0.0033μF
CH27,CH28	24636229	EL, 2.2μF
RESISTORS		
RH01,RH03, RH05,RH07, RH11,RH12, RH19,RH20, RH34,RH38, RH61,RH62	24360104	CF, 100K ohm
RH02,RH04, RH06,RH08, RH10,RH14, RH18,RH80, RH85,RH86, RH94,RH96	24360472	CF, 4.7K ohm
RH09,RH24, RH26,RH35, RH82,RH83	24360103	CF, 10K ohm
RH16	24360105	CF, 1M ohm
RH17,RH22, RH27,RH48, RH71	24360473	CF, 47K ohm
RH21,RH30, RH32,RH46, RH49,RH97	24360223	CF, 22K ohm
RH23,RH89	24360153	CF, 15K ohm
RH28,RH29, RH31,RH45, RH95	24360333	CF, 33K ohm
RH33,RH68, RH69	24360123	CF, 12K ohm
RH36	24360222	CF, 2.2K ohm
RH37	24360561	CF, 560 ohm
RH41	24360221	CF, 220 ohm
RH42	24360563	CF, 56K ohm
RH43	24360152	CF, 1.5K ohm
RH44	24360824	CF, 820K ohm
RH47	24360182	CF, 1.8K ohm
RH51	24061361	VR, 1M ohm, 0.15W
RH53	24061359	VR, 470K ohm, 0.15W
RH55	24061353	VR, 47K ohm, 0.15W
RH60	24360513	CF, 51K ohm
RH63,RH65, RH67,RH78	24360512	CF, 5.1K ohm
RH64	24360334	CF, 330K ohm
RH66	24360163	CF, 16K ohm
RH70	24360332	CF, 3.3K ohm
RH72,RH79	24360101	CF, 100 ohm
RH73	24360823	CF, 82K ohm
RH74	24360113	CF, 11K ohm
RH75	24360562	CF, 5.6K ohm
RH76	24360471	CF, 470 ohm
RH77,RH87, RH88,RH99	24360102	CF, 1K ohm

LOCATION NUMBER	PART NUMBER	DESCRIPTION
RH81	24360432	CF, 4.3K ohm
RH84,RH90, RH91	24360122	CF, 1.2K ohm
RH92	24360623	CF, 62K ohm
RH98	24360162	CF, 1.6K ohm
SEMICONDUCTORS		
ICH01,ICH02, ICH03	B0475282	IC, TC4528BP
ICH04	B0470407	IC, TC4040BP
ICH05,ICH08	B0470135	IC, TC4013BP
ICH06	B0470810	IC, TC4081BP
ICH07,ICH10	B0470693	IC, TC4069UBP
ICH09	B0470116	IC, TC4011BP
ICH11,ICH26	B0350010	IC, TA75458S
QH12,QH13, QH14,QH15, QH19,QH20, QH21,QH22, QH23,QH24, QH25	A6317540	NPN, Transistor, 2SC1815-Y
QH16,QH18	A6534040	PNP, Transistor, 2SA1015-Y
ICH27	B0470662	IC, TC4066BP
DH01,DH02, DH03,DH04, DH05,DH06, DH07,DH08, DH09,DH10, DH11,DH12, DH13,DH14, DH15,DH16, DH17,DH18, DH19,DH20, DH21,DH22, DH23,DH24, DH25,DH26 DH28	A7246700	Diode, 1S1555
DH27	A7286100	Zener Diode, 02Z-6.2A
MISCELLANEOUS		
PH01	23164790	Plug, 10P
PH02	23164785	Plug, 5P
PH03	23164788	Plug, 8P
PH04	23164783	Plug, 3P
PH05,PH06, PH07	23164784	Plug, 4P

INTER FACE BOARD ASSEMBLY PW2118

LOCATION NUMBER	PART NUMBER	DESCRIPTION
CAPACITORS		
CF31	24436241	CD, 240pF
CF32	24692224	PF, 0.22μF
CF33	24635220	EL, 22μF, 35V
CF34	24232103	CD, 0.01μF, +80%, -20%, 50V
CF35	24631222	EL, 2200μF, 6.3V
RESISTORS		
RF31,RF33, RF35,RF38, RF41,RF44, RF47	24360104	CF, 100K ohm
RF32,RF34, RF36,RF39, RF42,RF45, RF48	24360333	CF, 33K ohm
RF37	24360103	CF, 10K ohm
RF40,RF43, RF46,RF49	24360223	CF, 22K ohm

LOCATION NUMBER	PART NUMBER	DESCRIPTION
RF61,RF68, RF69,RF80, RF86	24380103	CF, 10K ohm
RF62,RF71, RF72	24380333	CF, 33K ohm
RF63	24963271	OMF, 270 ohm, ±5%, 1W
RF64	24380121	CF, 120 ohm
RF65,RF66	24360332	CF, 3.3K ohm
RF67,RF75	24380683	CF, 68K ohm
RF70	24380153	CF, 15K ohm
RF73,RF74	24380332	CF, 3.3K ohm
RF76,RF77	24380223	CF, 22K ohm
RF78	24962561	OMF, 560 ohm, ±5%, ½W
RF79	24360154	CF, 150K ohm
RF81	24962271	OMF, 270 ohm, ±5%, ½W
RF82	24380152	CF, 1.5K ohm
RF83,RF85	24380302	CF, 3K ohm
RF84	24380162	CF, 1.6K ohm
SEMICONDUCTORS		
ICF31	B0475142	IC, TC4514BP
QF32,QF33, QF34,QF35, QF36,QF37, QF38,QF39, QF42,QF44, QF45,QF46	A6317540	NPN, Transistor, 2SC1815-Y
QF40,QF41, QF43	A6534040	PNP, Transistor, 2SA1015-Y
DF31,DF32, DF33,DF34, DF35,DF36, DF37,DF38, DF39,DF40, DF41,DF42, DF43,DF44, DF45,DF46, DF47,DF49, DF61	A7246700	Diode, 1S1555
DF48	A7286100	Zener Diode, 02Z-6.2Z
DF62	A7000900	Diode, 1N60
MISCELLANEOUS		
PF35	23164756	Plug, 6P
PF32	23164732	Plug, 12P
PF33	23164793	Plug, 13P
PF34	23164755	Plug, 5P
PF31	23164760	Plug, 10P

SLACK SWITCH BOARD ASSEMBLY PW1750

RESISTOR		
R591	24360123	CF, 12K ohm
MISCELLANEOUS		
S591	23145836	Lead Switch, 20AT, 30AT

LOADING CONNECT BOARD ASSEMBLY PW1788

MISCELLANEOUS		
P671	23164784	Plug, 4P
P672	23164785	Plug, 5P

SLACK DELAY BOARD ASSEMBLY PW1789

CAPACITOR		
C821	24633330	EL, 33μF, 16V
RESISTOR		
R821	24360154	CF, 150K ohm

LOCATION NUMBER	PART NUMBER	DESCRIPTION
SEMICONDUCTORS		
D821	A7246700	Diode, 1S1555
D822	A7286100	Zener Diode, 02Z-6.2A
MISCELLANEOUS		
P821	23164756	Plug, 6P

CONNECTOR BOARD ASSEMBLY PW1720

RESISTORS		
R559	24060640	VR, 20K ohm, $^1/_5$W
R560	24054009	VR, 500K ohm, 5W
COILS AND TRANSFORMERS		
L652	70147002	Solenoid
L661	70212003	Coil, Sensing Coil, 0.18 MHz
⚠T811	23213325	Trans, TPW1148
MISCELLANEOUS		
P831	23164758	Plug, 3P
P832	23164753	Plug, 3P
S651	23145884	Switch, 1C2P
S652	70104010	Counter
S671,S672	23145838	Switch, 1C2P
⚠P811	23176998	Power Cord, 250V 2.5A 2.5A
P811A	70841119	Holder
P811F	70852021	Voltage Selector Cover
⚠P830	23163717	Voltage Selector
⚠P831	23145778	Switch, 2C2P (Mains)

SWITCH BOARD ASSEMBLY

SEMICONDUCTORS		
DA04,DA05, DA06,DA07, DA08,DA09, DA10,DA11, DA12,DA13	A8600605	LED, TLR113D
DA14,DA15, DA16,DA17, DA18,DA19, DA20,DA21, DA22,DA23, DA24,DA25, DA26,DA27, DA28,DA29, DA30,DA31, DA32,DA33	A7246700	Diode, 1S1555

NOISE CANCELLER BOARD ASS'Y PW2177

CAPACITOR		
CS01	24692104	PF, 0.1μF
RESISTORS		
RS01	24380393	CF, 39K ohm
RS02	24380104	CF, 100K ohm
RS03	24380223	CF, 22K ohm
RS04,RS06	24380103	CF, 10K ohm
RS05	24380223	CF, 22K ohm
RS07	24380204	CF, 200K ohm
RS08	24380472	CF, 4.7K ohm
SEMICONDUCTORS		
QS01	A6534040	PNP, Transistor, 2SA1015-Y
QS02,QS03	A6317540	NPN, Transistor, 2SC1815-Y

MODULE UNITS AND CIRCUIT BOARD ASSEMBLY

U001	70191358	Selector Board Ass'y PW2139
U011	70191400	Setting Board Ass'y, PW2187
U022	23145843	Key Board Ass'y
U031	70191344	Converter Board Ass'y, PW2087
U101	70191319	Audio Board Ass'y, PW2108
U201	70191320	Video Board Ass'y, PW2109
U501	70191321	Servo and Logic Board Ass'y, PW2110
U801	70191389	Power Board Ass'y, PW2237
U861	70191353	Timer Board Ass'y, PW2112
U871	70191354	Inter Face Board Ass'y, PW2118
U901	70191324	Pause Board Ass'y, PW2113
U941	70191325	Plunger Board Ass'y, PW2114
U961	70191326	Disk Drive Board Ass'y PW2115
U981	70191327	Switch Board Ass'y, PW2116
UH01	70191328	Speed Control Board Ass'y, PW2117
U591	70191196	Slack Switch Board Ass'y, PW1750
U671	70191222	Loading Connect Board Ass'y, 1788
U821	70291207	Slack Delay Board Ass'y, PW1789
U831	70191171	Connector Board Ass'y, PW1720
US01	70191390	Noise Canceller Board Ass'y, PW2177

MECHANICAL PARTS LISTS

LOCATION NUMBER	PART NUMBER	DESCRIPTION
		1. CABINET ASSEMBLY
A101	70812913	Front Cover
A102	70814978	Top Cover
A102A	70923985	Blower Cover
A102B	70817987	Door
A103	70810994	Cassette Compartment Cover
A104	70817989	Back Cover
A105	70813974	Side Plate (R)
A106	70813975	Side Plate (L)
A107	70813973	Bottom Cover
A108	70810993	Tag Holder Ass'y
A201	70816131	Switch Knob (3 PCS)
A201A	70810002	Switch Cover (3 PCS)
A202	70816132	Switch Knob (3 PCS)
A202A	70810011	Switch Cover (3 PCS)
A203	70816127	Knob, for Setting Switch
A203A	70810008	Setting Switch Cover
A204	70816130	Knob, for Programme Switch
A205	70816128	Knob, Push Button (4 PCS)
A206	70816129	Knob, for Tracking
A207	70816161	Knob, for Speed Control
		2. FRONT AND BACK CHASSIS ASSEMBLY
B207	70351210	EE, Switch Slider Spring
B209,B213	70351211	Record Slider Spring
B211,B215	70351212	Record Switch Spring
B617	70342061	Counter Belt
B618	70318013	Relay Pulley Ass'y
C641	24076017	EL, 3300μ, 25V
		3. LEFT AND BACK CHASSIS ASSEMBLY
B317	70341155	Guide Pulley Ass'y
B320	70342049	Guide Pulley Belt
B321	70342050	FF, REW Belt
B608	70815017	Foot
⚠Q801	A6836940	Power TR 2SD369Y
		4. TUNER BLOCK ASSEMBLY
H001	23121896	Combination Tuner EG111
H003	70142014	Antenna Terminal Board VT602
H004	70123030	RF Unit MD3536
H005	70142012	Booster BSTE35
C050	24692104	PF, 0.1μF
C051	24633470	EL, 47μF, 16V
C052	24635100	EL, 10μF, 35V
		5. REEL CHASSIS (SLIDER) ASSEMBLY
K115	70351182	EJECT Return Spring
K133F	70351319	EJECT Bias Spring
		6. REEL CHASSIS ASSEMBLY
K124	70351178	Brake Logic Spring
K125	70326101	FF Brake Ass'y
K127	70351192	FF Brake Spring
K128	70326270	Tape Guide Bracket Ass'y
K129	70326079	Supply Reel Brake Ass'y
K130	70351164	Brake Logic Spring
K131A	23002200	SRS-E2 SUS
K135B	70331062	REW Idler Ass'y
K137	70326092	FF Idler Ass'y
K139	70326283	Play Idler Ass'y
K140	70326082	Band Brake Ass'y
K141	70342036	Play Belt
K144C	70351164	Brake Logic Spring
K201	70317009	Take-Up Reel Ass'y
K202	70317010	Supply Reel Ass'y
K203	70394048	Reel Table Washer
K204	70348028	Thrust Bearing
K206	70342037	Counter Reel Belt

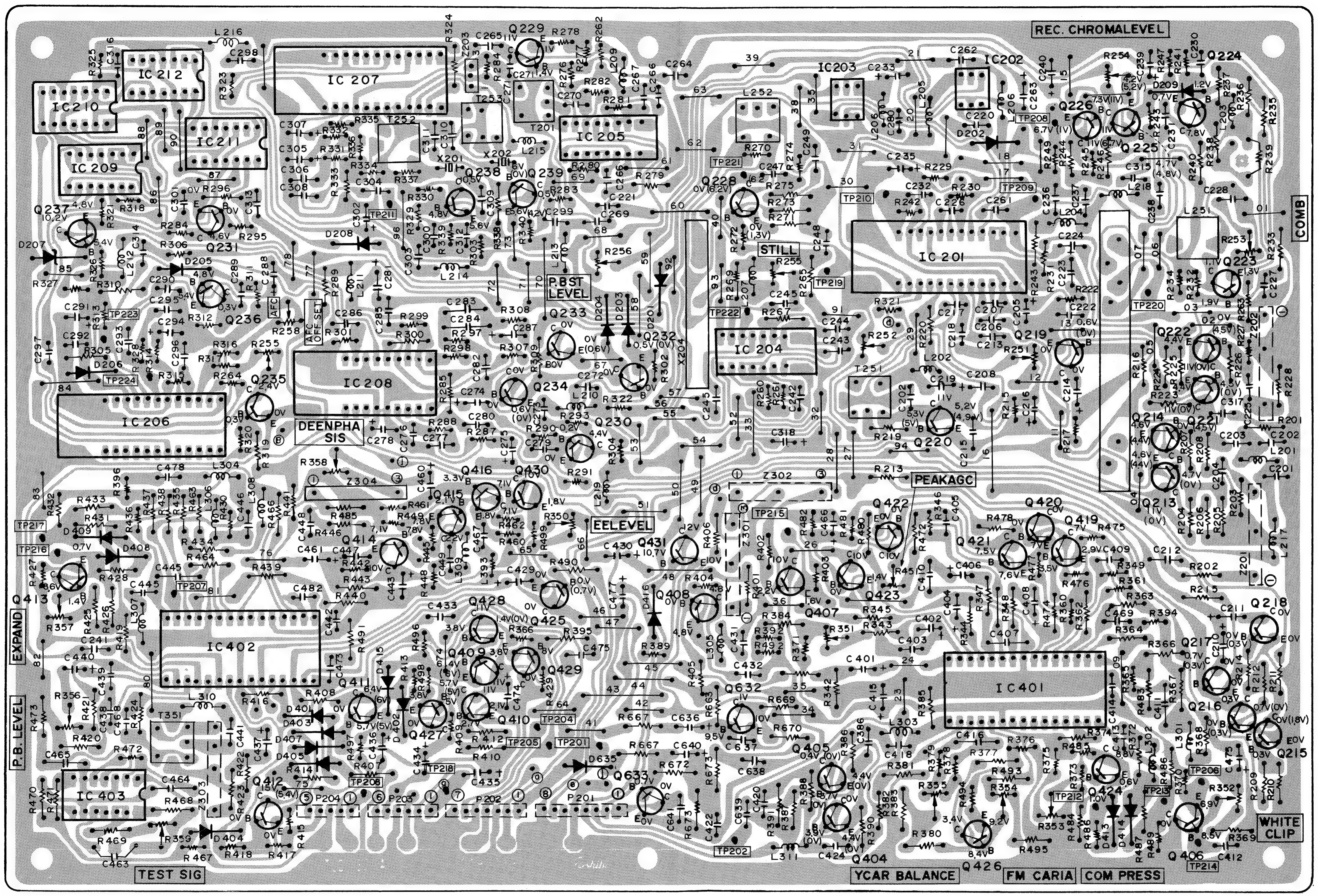
LOCATION NUMBER	PART NUMBER	DESCRIPTION
K501	70326263	Tension Lever Ass'y
K502	70351213	Tension Spring
L651	70210006	Auto Stop Solenoid
L662	70212003	Sensing Coil
S681	23145838	Stop Solenoid Micro Switch
		7. CASSETTE COMPARTMENT ASSEMBLY
K301	70324068	Lifter Ass'y
K302	70348041	Lifter Roller
K303	70324073	Lock Out Lever
K304	70351185	Lifter Spring
K305C	70354015	Cassette Compartment Cushion
K310	70324082	Eject Wire
K310A	23002200	SRS-E2 SUS
K311	70324083	Record Safety Plate
K314	70351188	Bias Spring
K505	70314022	Cassette Compartment Ass'y
K505E	70352035	Cassette Compartment Spring (L)
K505F	70352036	Cassette Compartment Spring (R)
L691	70191170	Lead Switch Board Ass'y PW-1719
S691	23145836	Lead Switch
P691	23164753	Plug, 3P
		8. PUSH BUTTON ASSEMBLY
K401	70313033	Button Ass'y
K404	70323216	EJECT Button
K405	70323211	FF, REW Button
K406	70323218	STOP Button
K407	70323214	PLAY Button
K408	70323222	REC Button
K409	70323222	AUDIO DUB Button
K413F	23002200	SRS-E2 SUS
S661, S662, S663, S664	23145823	Leaf Switch
		9. MAIN BASE ASSEMBLY
B102	70328203	Pinch Lock Lever
B105	70351203	Pinch Lock Spring
B106	70351214	Play Lever Spring
B110	70351205	Pause Lever Spring
B111	70358003	Remote Control Pause Pusher
B112	70328174	Cam Follower Lever Ass'y
B113	70328245	Shift Lever Ass'y
B115	70328070	Detect Lever Ass'y
B116	70351207	Detect Lever Spring
B117	70328072	Roller Plate Ass'y
B117C,B118	70328102	Loading Ring Roller
B117D,B119	70328115	Loading Ring Upper Roller
B123	70351214	Play Lever Spring
B125	70328213	Slack Lever Ass'y
B127	70351202	Slack Lever Spring
B129	70351315	Pause Spring
K143	70351206	Cam Follower Spring
B205	70351209	AUDIO DUB Switch Lever Spring
B304	70335012	Capstan Flywheel Ass'y
B305	70335003	Capstan Cap
B306	70328104	Oil Reserver
B319	70342048	Capstan Belt
B323	70341243	Motor Pulley Ass'y (A)
B323	70341244	Motor Pulley Ass'y (B)
B323	70341245	Motor Pulley Ass'y (C)
B323	70341246	Motor Pulley Ass'y (D)
B323	70341247	Motor Pulley Ass'y (E)
B323	70341248	Motor Pulley Ass'y (F)
B323	70341249	Motor Pulley Ass'y (G)
B401	70312026	Loading Ring Ass'y
B404	70322037	Pinch Roller Ass'y
B406	70348040	Roller (4 PCS)

MECHANICAL PARTS LIST

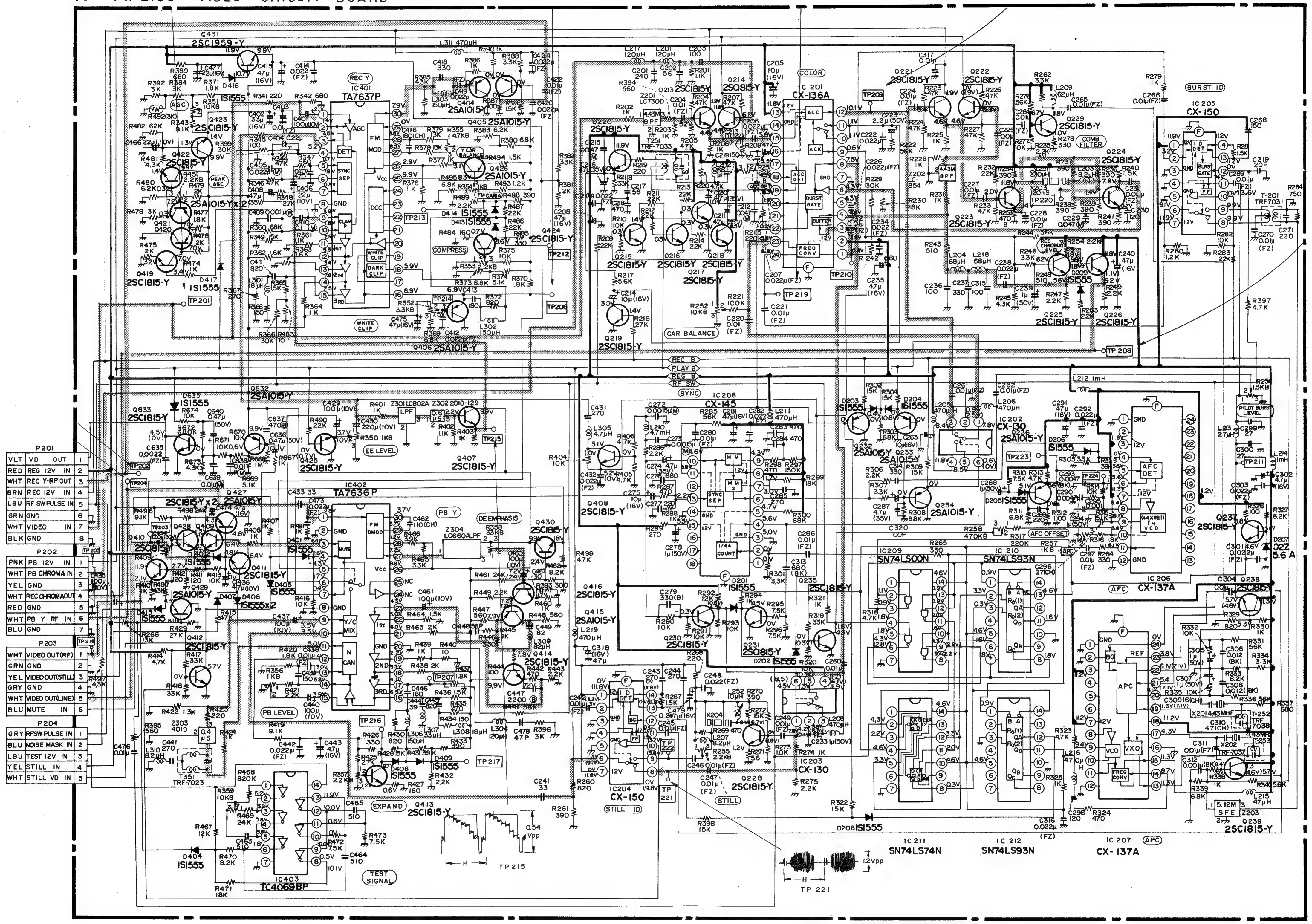
LOCATION NUMBER	PART NUMBER	DESCRIPTION
B501	70312033	Loading Drive Ass'y
B506	70342059	Loading Belt
M002	70125051	Capstan Drive Motor
		10. CYLINDER ASSEMBLY
G011	70311045	Cylinder Ass'y
G120	70321320	Video Head Disk Ass'y
G131	70321264	Upper Cylinder
G132	70321082	Tape Holder
G140A	70321093	Washer
R699	70420007	Dew Sensor
M001	70125047	Cylinder Motor
G151	70125034	Rotor
G152	70125043	Stator
G145B	70213015	Heater
G212	70183007	Inlet Guide Plate (Lower)
H031	70182014	Audio/Ctl Head Ass'y
H032	70183008	Fully Width Erase Head Ass'y

LOCATION NUMBER	PART NUMBER	DESCRIPTION
		11. PACKING ASSEMBLY
A701	70913045	Carton Box
A702	70921032	Cushion Front
A703	70921033	Cushion Back
A704	70922017	Protect Sheet
A705	70922018	Polyethylene Bag
A706	70921038	Tray
(Y101)	70941104	Owner's Manual (E)
(Y101)	70491105	Owner's Manual (D)
(Y101)	70941106	Owner's Manual (F)
(Y103)	70942030	Caution Sheet
(Y104)	70942031	Quick Reference Card (E)
(Y104)	70942032	Quick Reference Card (D)
(Y104)	70942033	Quick Reference Card (F)
(Y107)	70168035	Cable, for PAL/SECAM
(Y113)	70148005	Remote Control Hand Set
(Y120)	70923012	Dust Cover
(Y121)	70933020	Cover

WIRING DIAGRAM OF VIDEO CIRCUIT (PW2109)



U 201 PW 2109 VIDEO CIRCUIT BOARD



WIRING DIAGRAM OF SERVO AND LOGIC CIRCUIT (PW2110)

P505

1	P802 - 8
2	
3	P802 - 6
4	P802 - 7
5	P803 - 3
6	P831 - 6
7	P803 - 2

P506

1	M002
2	
3	M002

P507

1	
2	P963 - 3
3	P831 - 7
4	P903 - 6

P606

1	P672 - 2		
2	P831 - 1		
3	P666 - 3	8	P661 - 1
4	P661 - 2	9	P903 - 1
5	PH03 - 5	10	P903 - 2
6	PH01 - 4	11	P981 - 7
7	P903 - 5	12	P981 - 8

P604

1	H003
2	GND
3	H003

P605

1	
2	P803 - 8
3	P803 - 1

P601

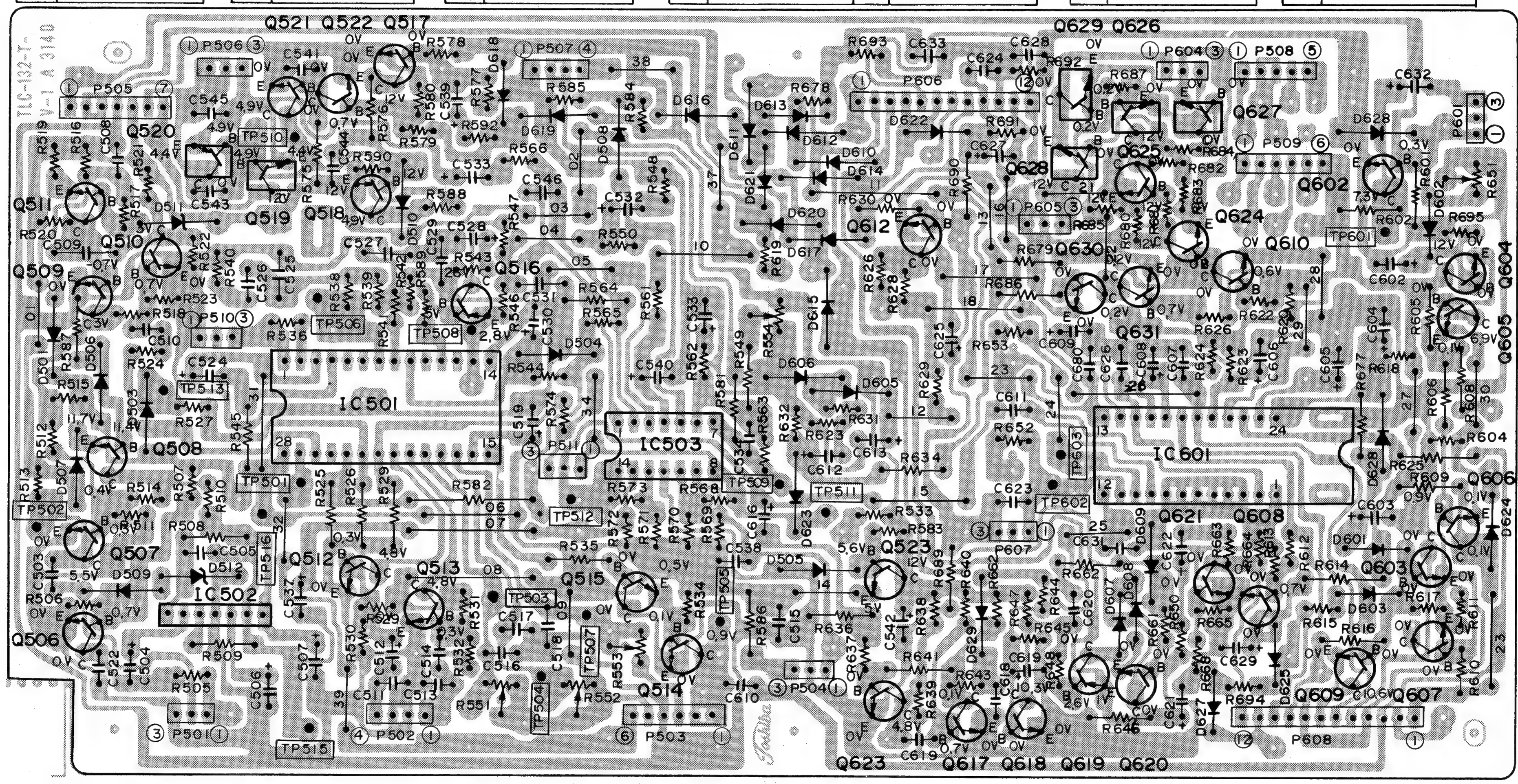
1	R699
2	
3	R699

P508

1	PH01 - 3
2	P901 - 10
3	PH01 - 7
4	PH01 - 2
5	PH07 - 3

P509

1	PH03 - 7
2	PH03 - 8
3	PH06 - 4
4	PH03 - 6
5	PH07 - 2
6	PH03 - 2



P510

1	GND
2	
3	P963 - 6

P501

1	GND
2	H031
3	H031

P502

1	H022
2	H022
3	H021
4	H021

P511

1	
2	PH07 - 1
3	

P503

1	P201 - 5
2	P103 - 5
3	P559 - ③
4	GND
5	P559 - ①,②
6	P201 - 1

P504

1	M002
2	
3	M002

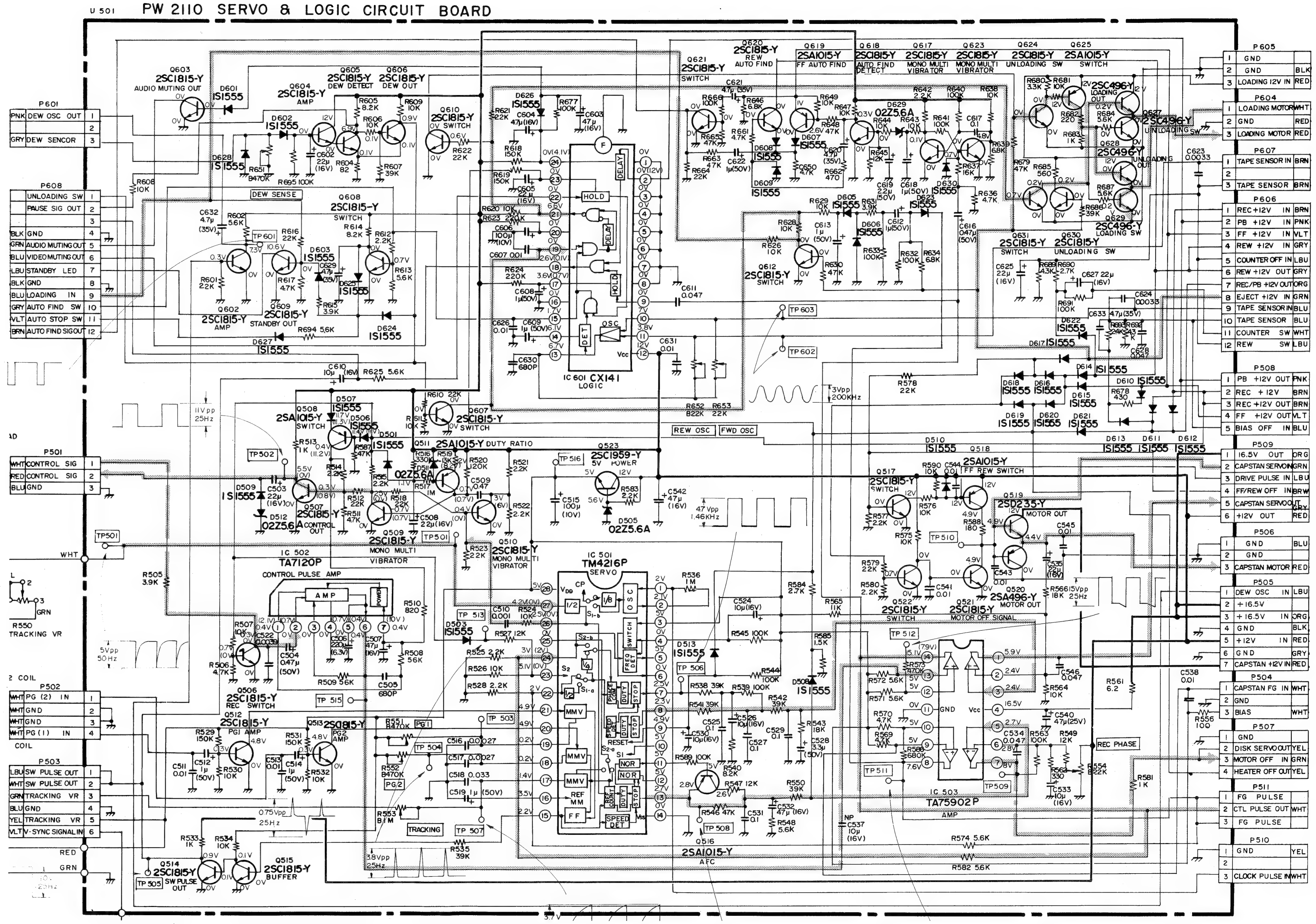
P607

1	L662
2	
3	L662

P608

1			
2			
3		8	P982 - 2
4	PH03 - 1	9	P672 - 4
5	P703 - 2	10	P981 - 4
6	P203 - 6	11	P903 - 10
7	P982 - 1	12	P903 - 3

U 501 PW 2110 SERVO & LOGIC CIRCUIT BOARD



WIRING DIAGRAM OF SPEED CONTROL CIRCUIT (PW2117)

PH03

8	P509 2
7	P509 1
6	P509 4
5	P606 5
4	GND
3	P203 3
2	P509 6
1	P608 4

PH04

3	Slow VR 1
2	〃 3
1	〃 2

PH07

4	P821 1
3	P508 5
2	P509 5
1	P511 2

PH06

4	P509 3
3	P204 1
2	P901 13
1	P983 4

PH02

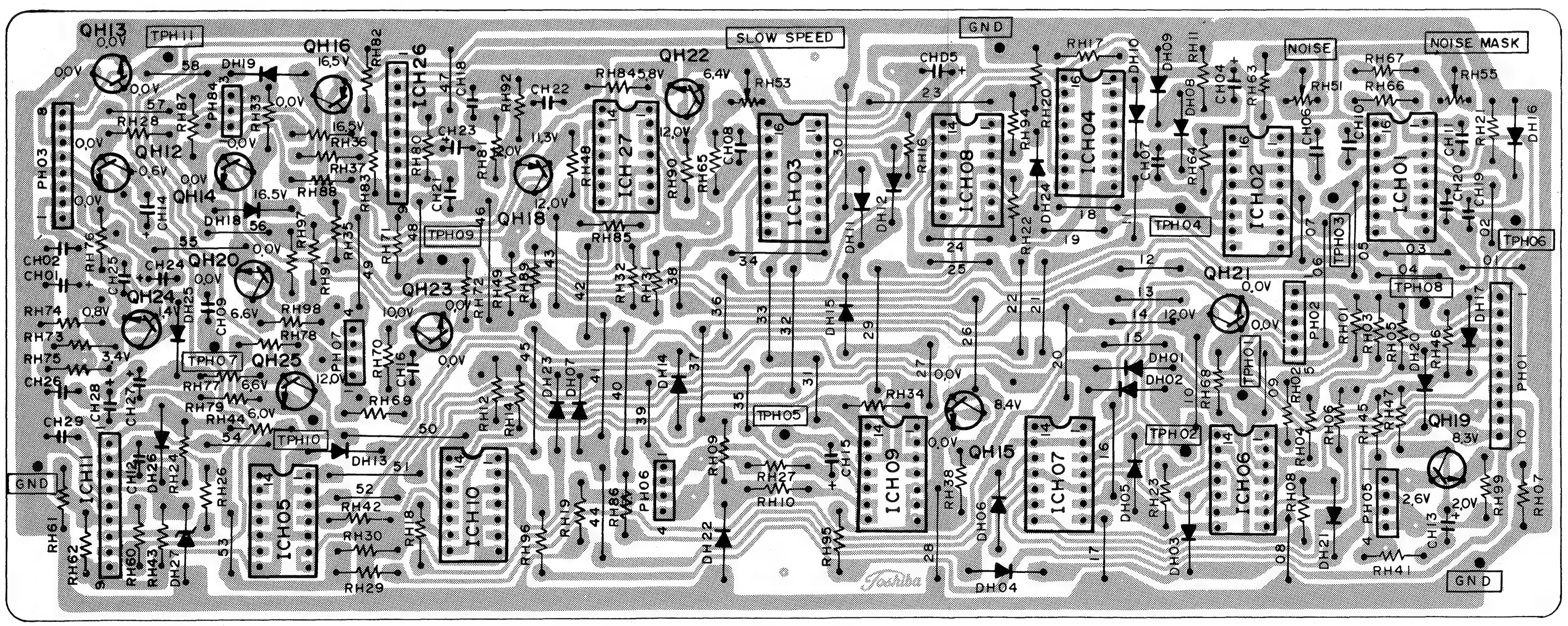
1	P962 3
2	P962 1
3	P962 2
4	P962 4
5	Open

PH05

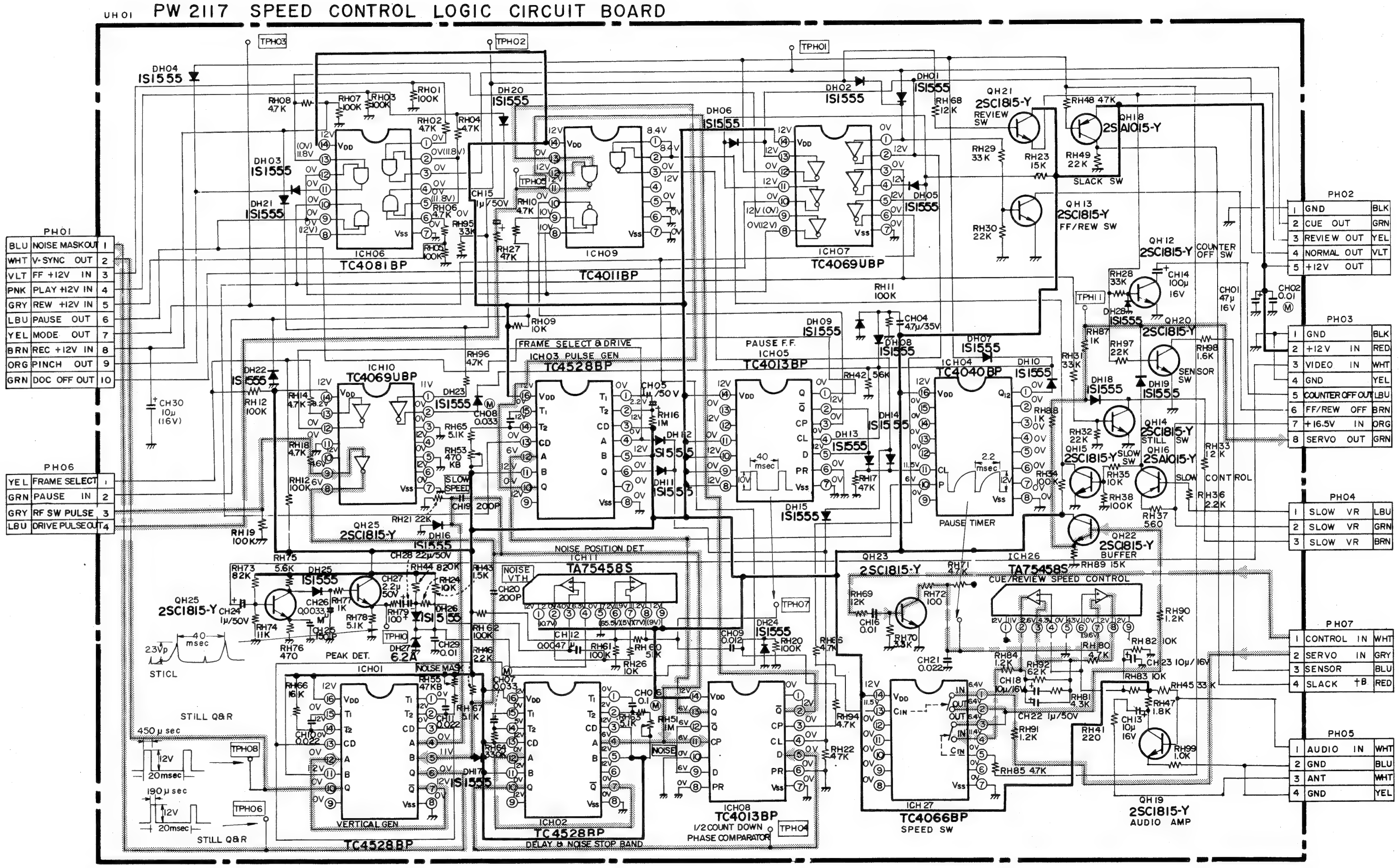
1	P703 4
2	P703 5
3	P012 3
4	P012 4

PH01

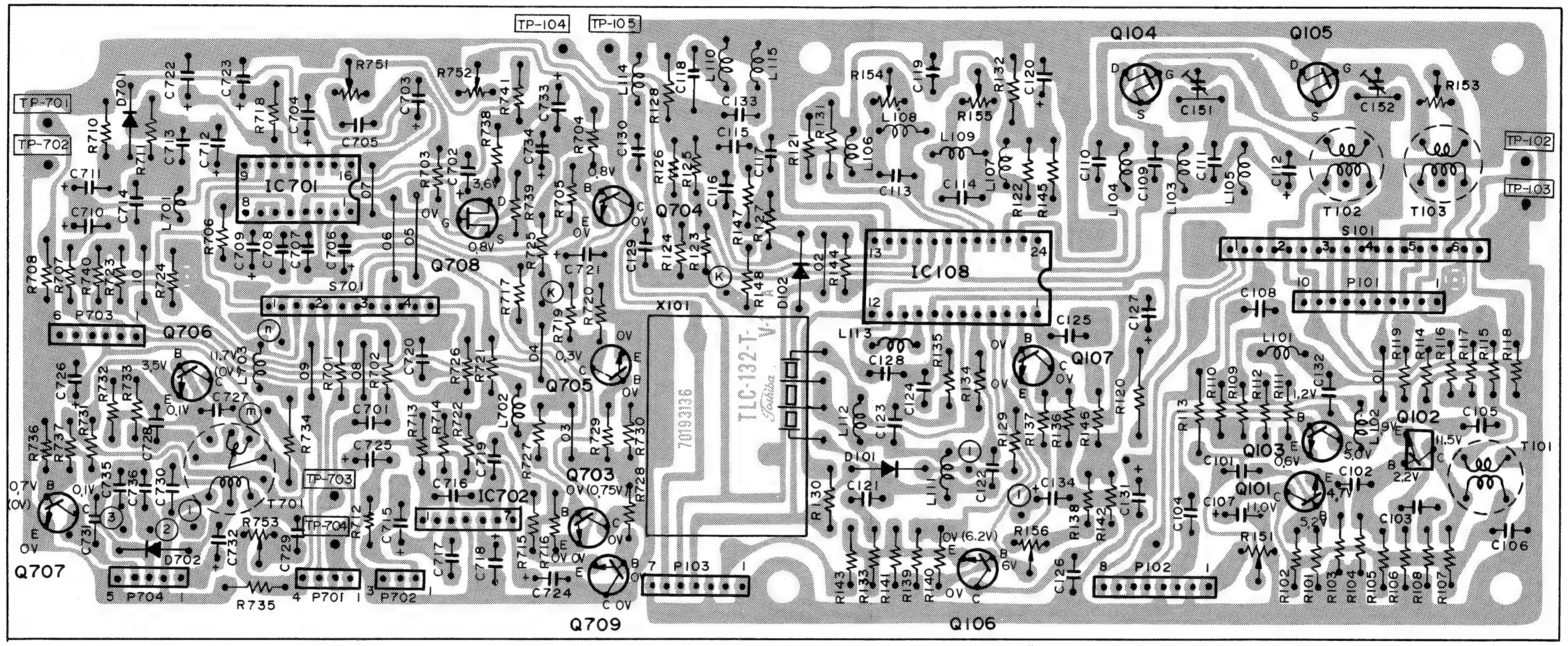
1	P204 2
2	P204 5
3	P508 4
4	P508 1
5	P606 6
6	P901 8
7	P204 4
8	P508 3
9	P901 6
10	P103 4



UH01 PW 2117 SPEED CONTROL LOGIC CIRCUIT BOARD



WIRING DIAGRAM OF AUDIO CIRCUIT (PW2108)



P703

1	P831 - 4
2	P608 - 5
3	P982 - 4
4	PH05 - 1
5	PH05 - 2
6	P804 - 5

P704

1	H032
2	GND
3	H032
4	H032
5	GND

P701

1	
2	GND
3	H031
4	H031

P702

1	P652
2	GND
3	

P103

1	P804 - 6
2	P202 - 6
3	P202 - 7
4	PH01 - 9
5	P503 - 2
6	P202 - 2
7	P202 - 3

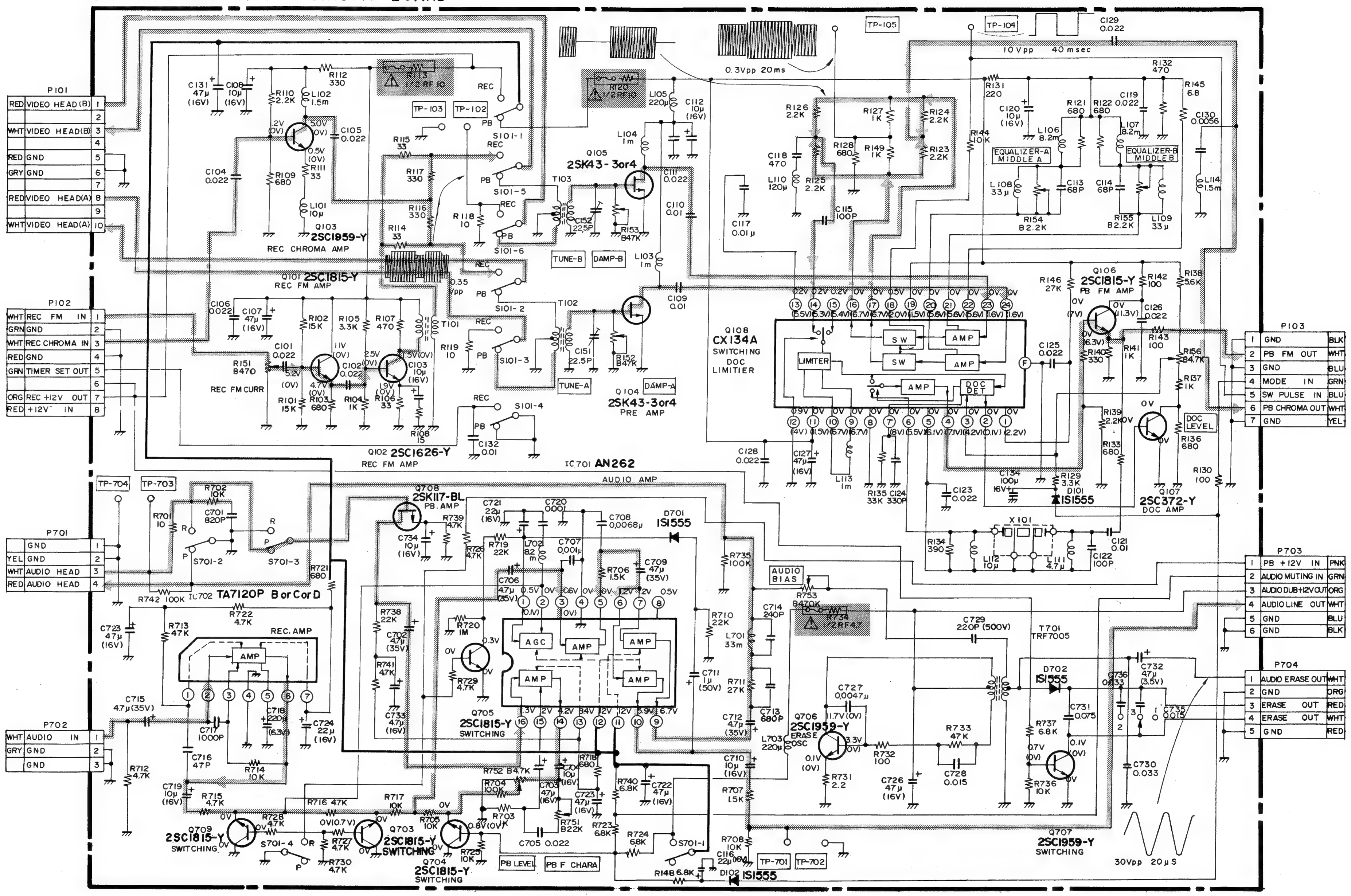
P102

1	P201 - 3
2	P201 - 6
3	P202 - 4
4	P202 - 5
5	P801 - 2
6	P981 - 2
7	P672 - 3
8	P804 - 2

P101

1	T301 R.T. TRANS
2	
3	T301, R.T. TRANS
4	
5	GND
6	GND
7	
8	T301. R.T.TRANS
9	
10	T301.R.T. TRANS

U 101 PW 2108 AUDIO CIRCUIT BOARD



WIRING DIAGRAM OF POWER CIRCUIT (PW2237)

P804

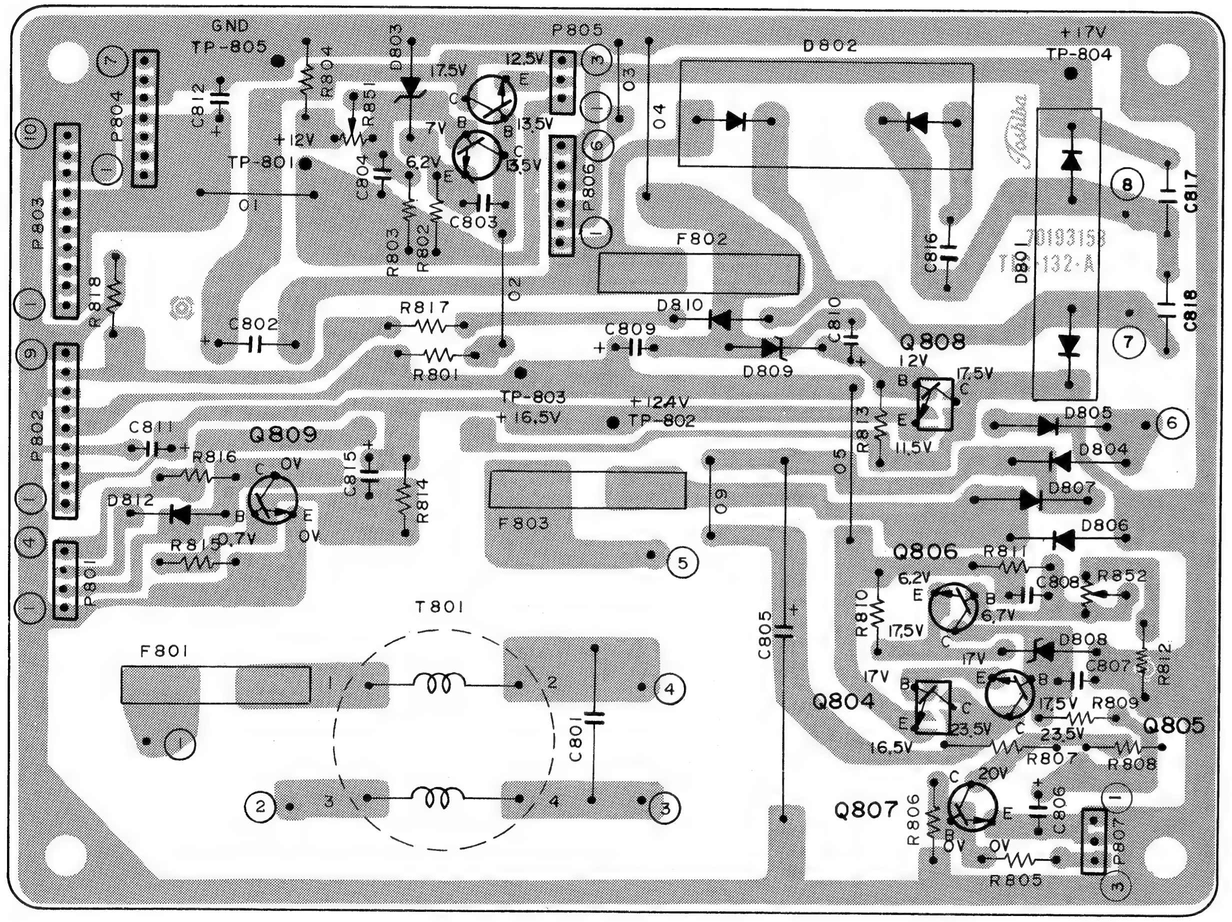
1	P201 - 2
2	P102 - 8
3	P691 - 3
4	P963 - 2
5	P703 - 6
6	P103 - 1
7	L651

P805

1	Q801 - E
2	Q801 - B
3	Q801 - C

P806

1	P981 - 1
2	P821 - 6
3	P963 - 1
4	P901 - 3
5	P963 - 4
6	P982 - 8



P801

1	C641 (-)
2	P102 - 5
3	P821 - 2
4	C641

P802

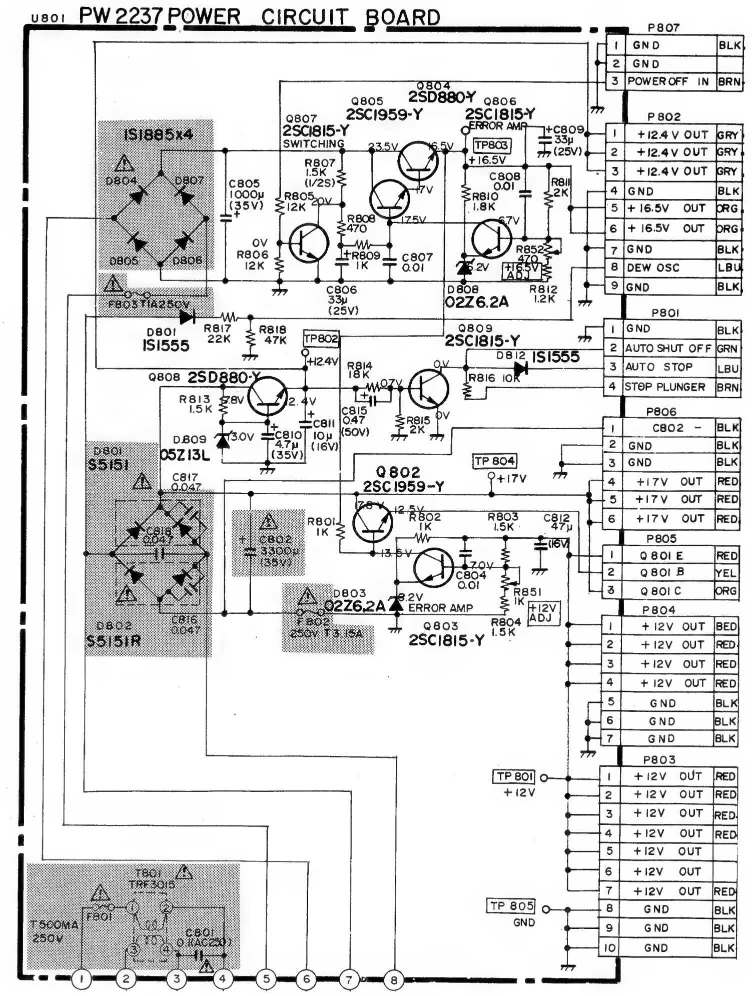
1	P012 - 14
2	P875 - 5
3	P982 - 9
4	P012 - 13
5	P012 - 15
6	P505 - 3
7	P505 - 4
8	P505 - 1
9	P901 - 2

P803

1	P605 - 3
2	P505 - 7
3	P505 - 5
4	S651
5	
6	
7	P982 - 3
8	P605 - 2
9	P831 - 8
10	P875 - 6

P807

1	P982 - 5
2	
3	P982 - 10



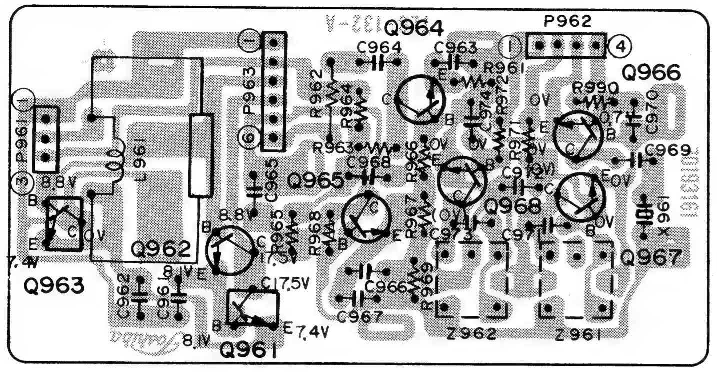
WIRING DIAGRAM OF DISK DRIVE CIRCUIT (PW2115)

P963

1	P806 - 3
2	P804 - 4
3	P507 - 2
4	P806 - 5
5	GND
6	P510 - 3

P961

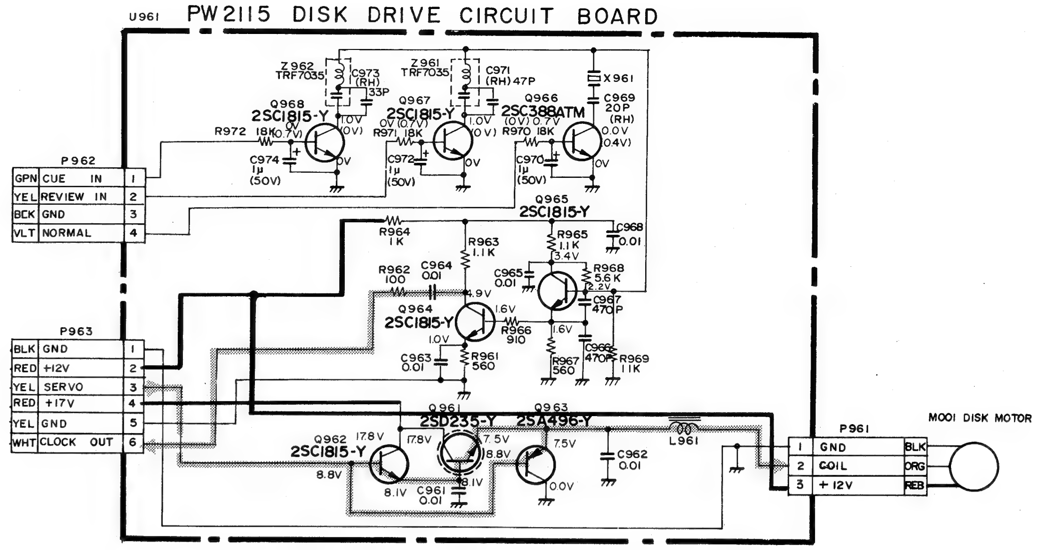
1	DISK MOTOR
2	DISK MOTOR
3	DISK MOTOR



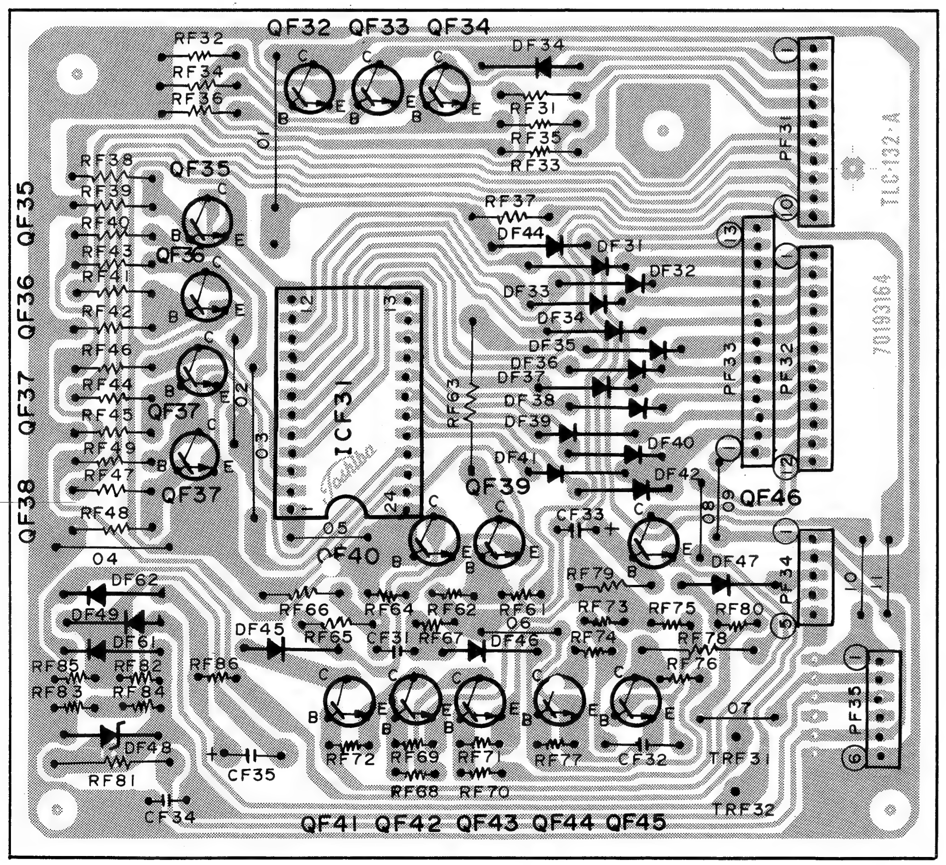
P962

1	PH02 - 2
2	PH02 - 3
3	PH02 - 1
4	PH02 - 4

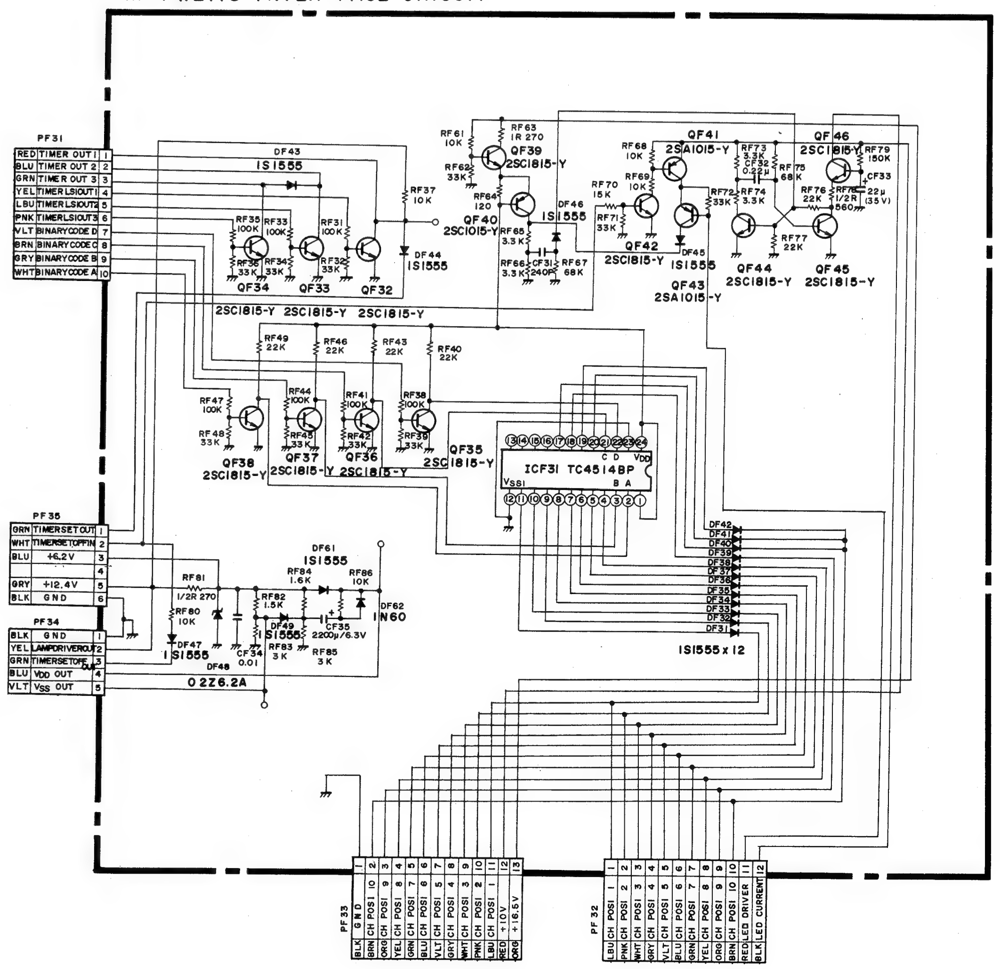
U961 PW2115 DISK DRIVE CIRCUIT BOARD



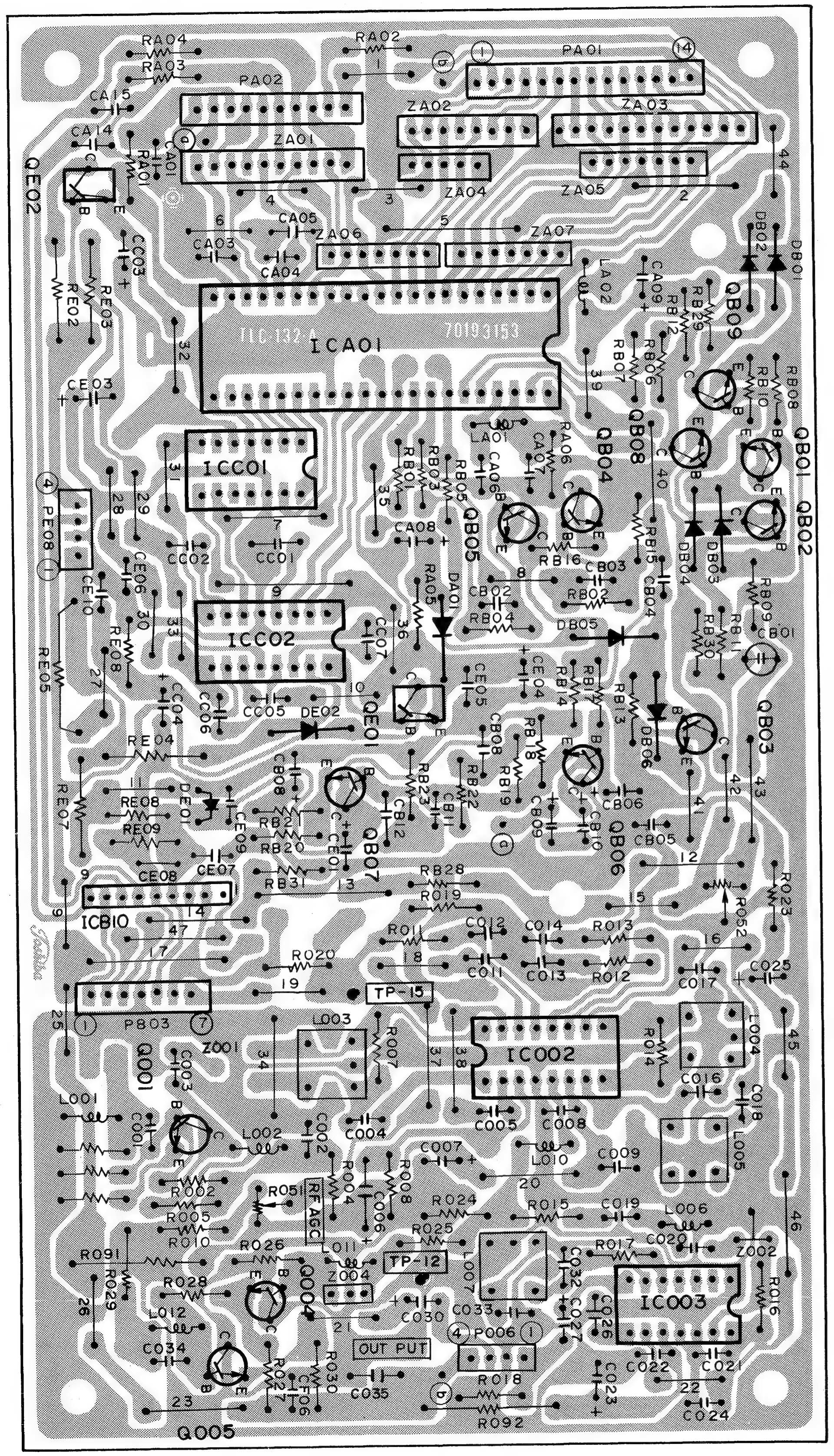
WIRING DIAGRAM OF INTERFACE CIRCUIT (PW2118)

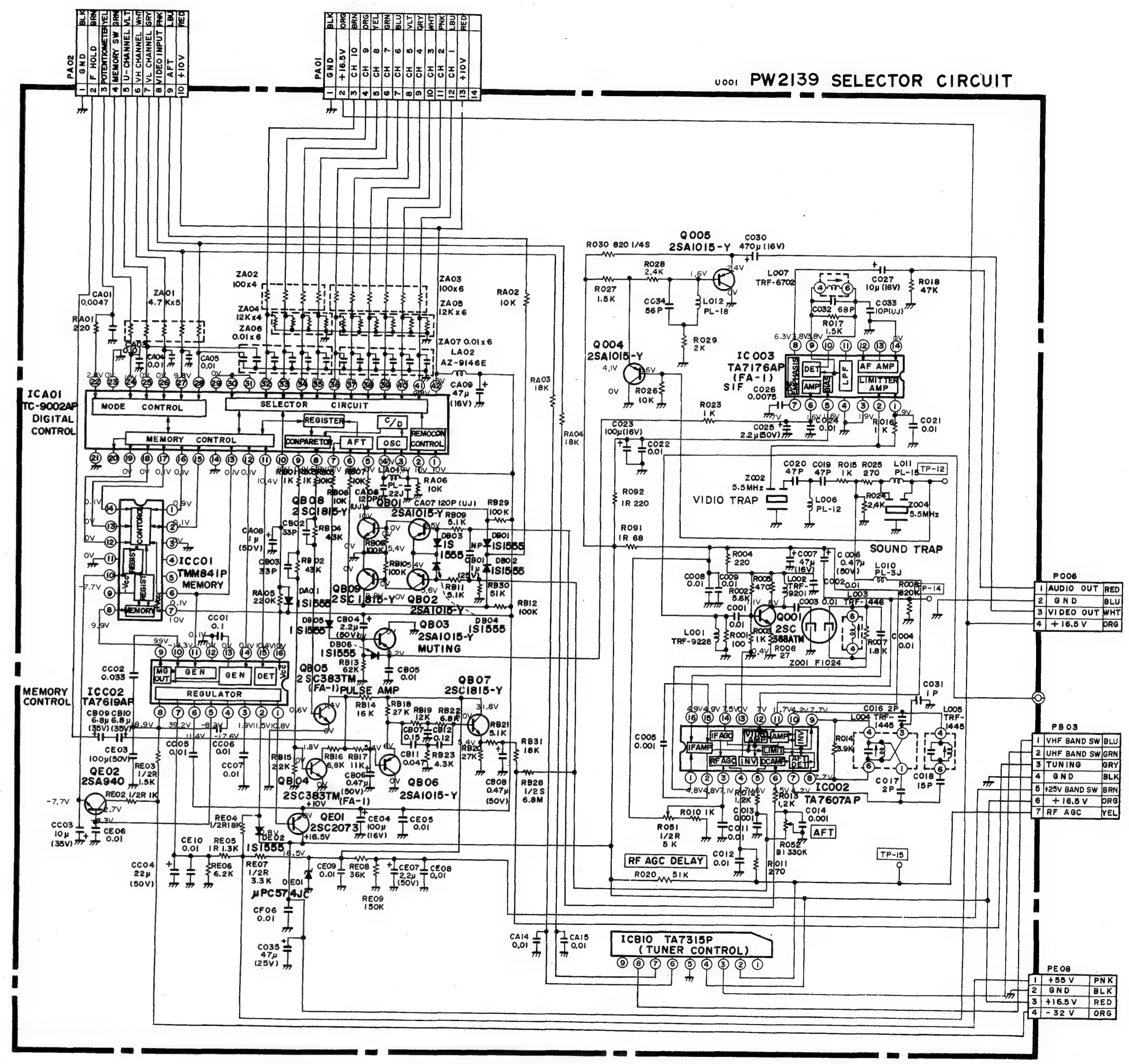


U871 PW2118 INTER FACE CIRCUIT

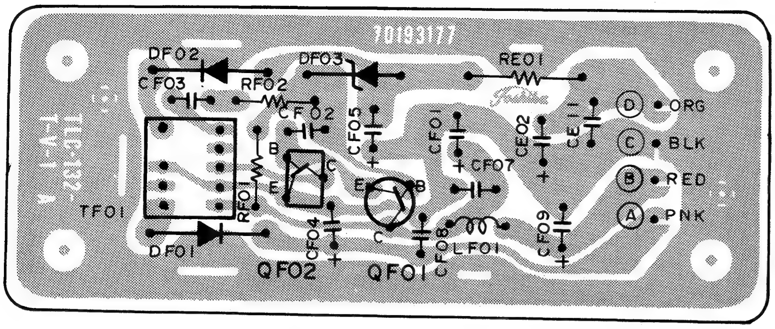


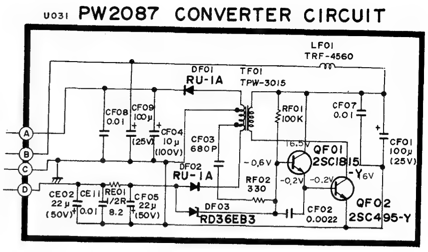
WIRING DIAGRAM OF SELECTOR CIRCUIT (PW2139)



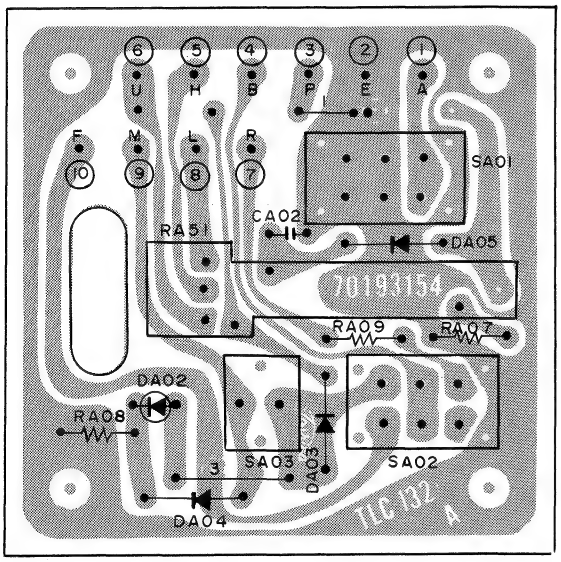


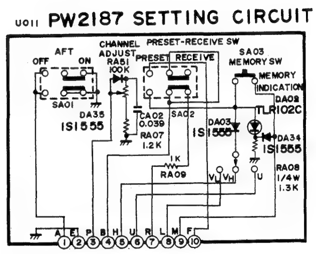
WIRING DIAGRAM OF CONVERTER CIRCUIT (PW2087)



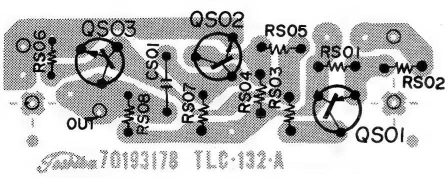


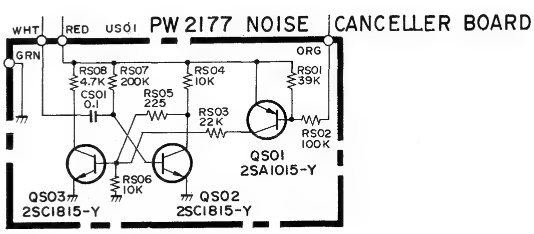
WIRING DIAGRAM OF SETTING CIRCUIT (PW2187)



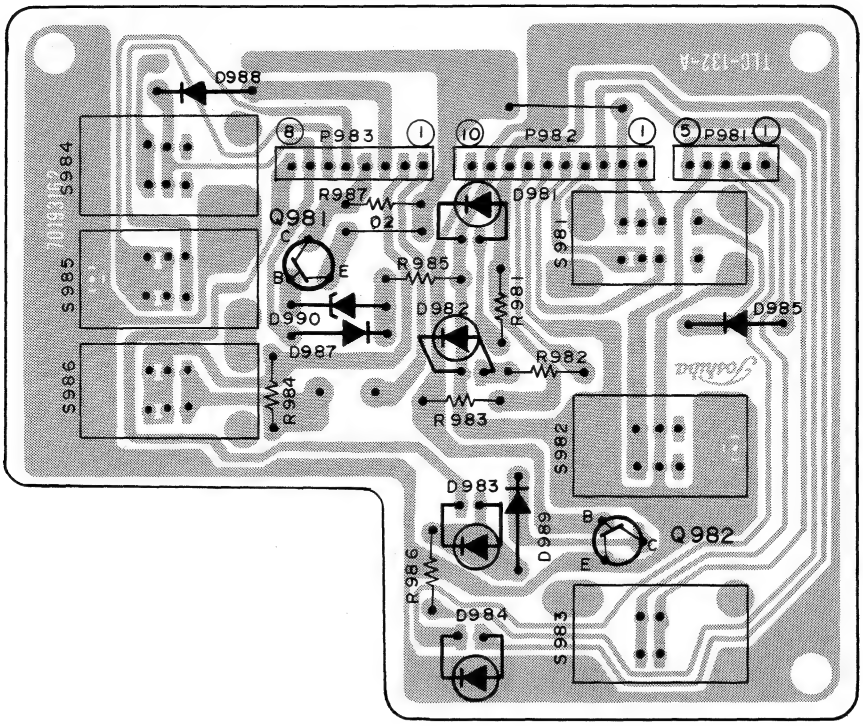


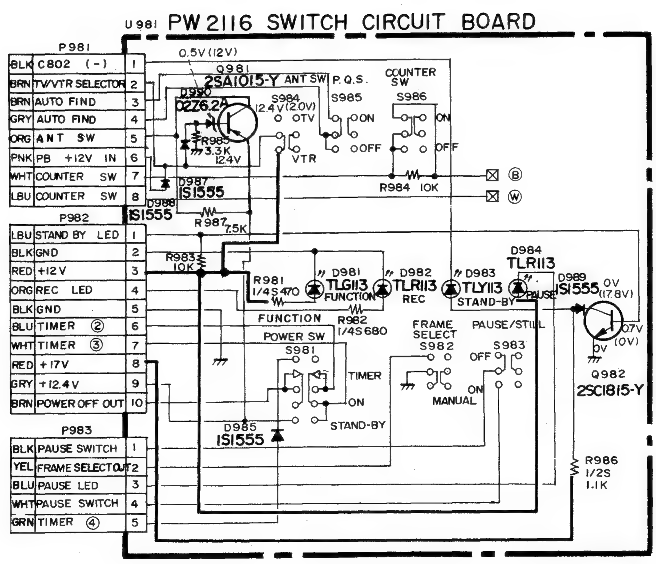
WIRING DIAGRAM OF NOISE CANCELLER CIRCUIT (PW2177)





WIRING DIAGRAM OF SWITCH CIRCUIT (PW2116)

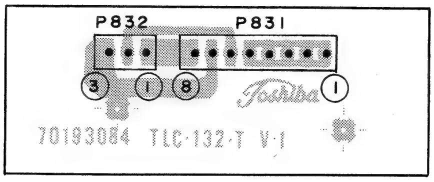




WIRING DIAGRAM OF CONNECTOR CIRCUIT (PW1720)

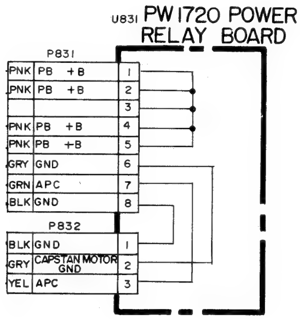
P832

1	S681
2	S681
3	S681

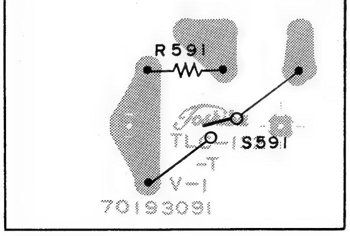


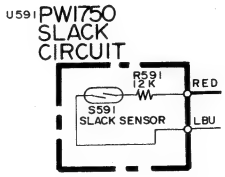
P831

1	P606 - 2
2	P661 - 4
3	
4	P703 - 1
5	P981 - 6
6	P505 - 6
7	P507 - 3
8	P803 - 9



WIRING DIAGRAM OF SLACK SWITCH CIRCUIT (PW1750)





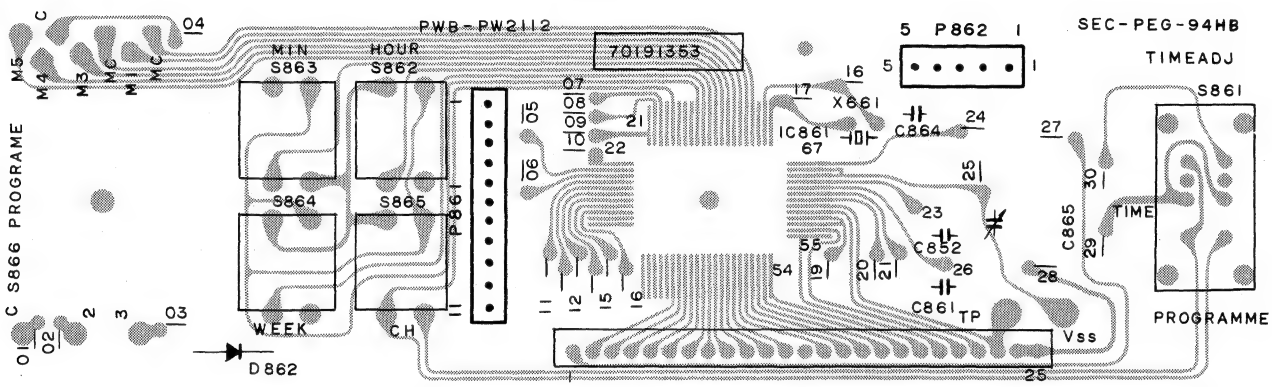
WIRING DIAGRAM OF TIMER CIRCUIT (PW2112)

P861

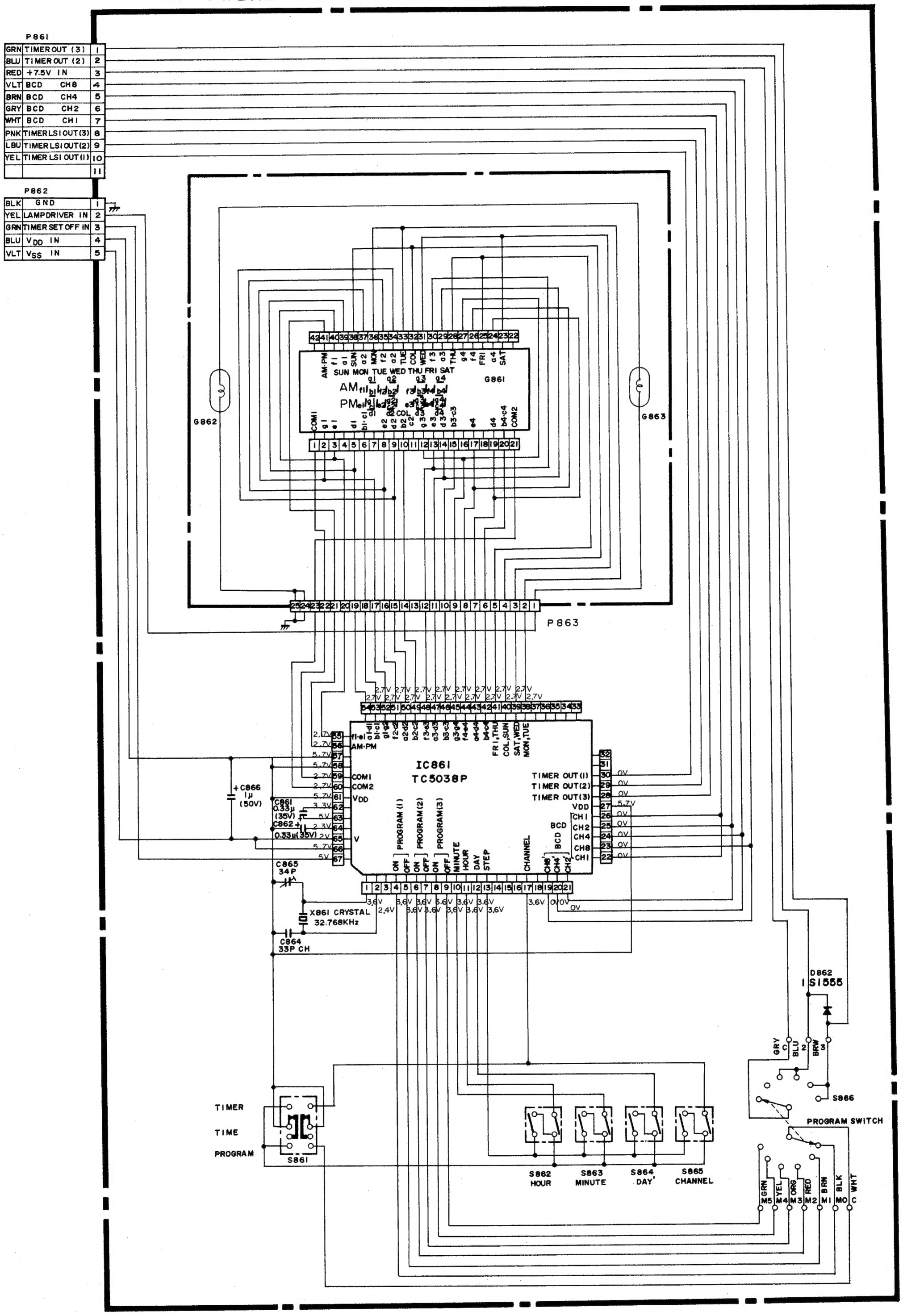
1	PF31 - 3
2	PF31 - 2
3	PF31 - 1
4	PF31 - 7
5	PF31 - 8
6	PF31 - 9
7	PF31 - 10
8	PF31 - 6
9	PF31 - 5
10	PF31 - 4
11	

P862

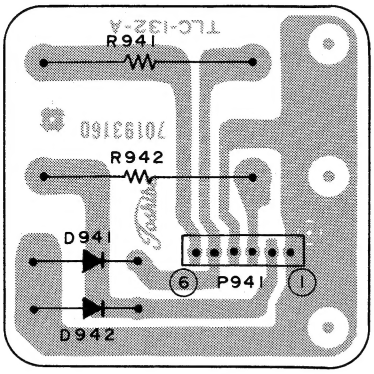
1	PF34 - 1
2	PF34 - 2
3	PF34 - 3
4	PF34 - 4
5	PF34 - 5



U861 PW2112 PROGRAM TIMER CIRCUIT

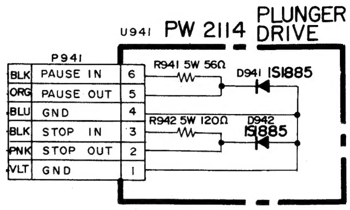


WIRING DIAGRAM OF PLUNGER CIRCUIT (PW2114)

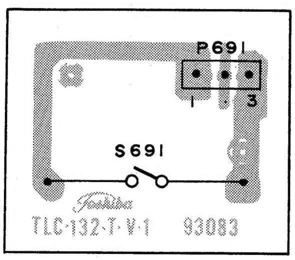


P941

1	P651
2	L651
3	P903 - 8
4	L651
5	P821 - 4
6	P901 - 5

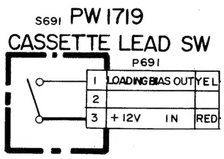


WIRING DIAGRAM OF LEAD SWITCH CIRCUIT (PW1719)

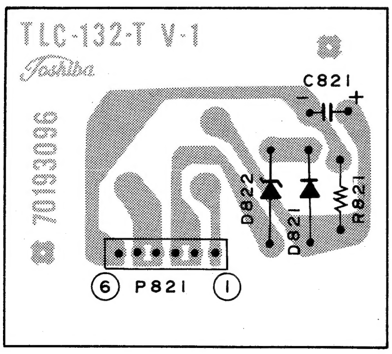


P691

1	P672 - 5
2	
3	P804 - 3

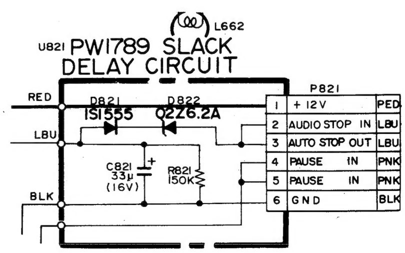


WIRING DIAGRAM OF SLACK DELAY CIRCUIT (PW1789)



P821

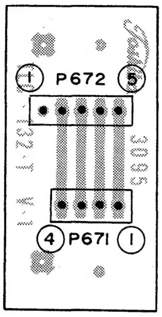
1	PH07 - 4
2	P801 - 3
3	P903 - 11
4	P941 - 5
5	P901 - 4
6	P806 - 2



WIRING DIAGRAM OF LOADING CONNECT CIRCUIT (PW1788)

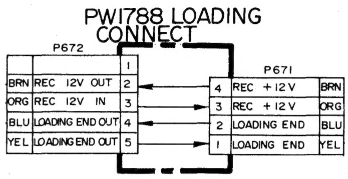
P672

1	
2	P606 – 1
3	P102 – 7
4	P608 – 9
5	P691 – 1

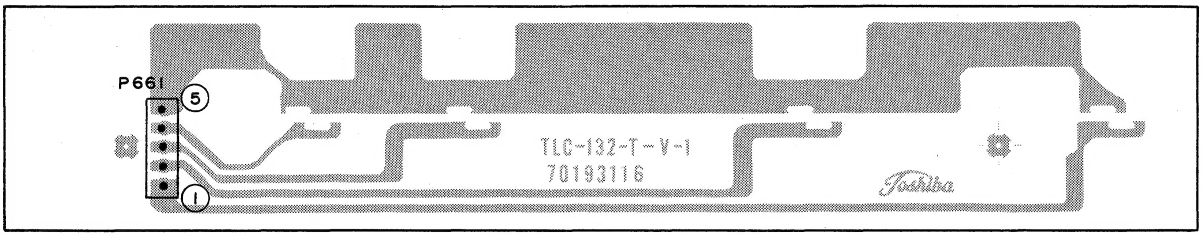


P671

1	S681
2	S681
3	S682
4	S682

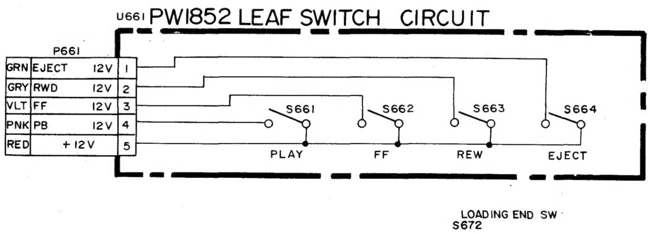


WIRING DIAGRAM OF LEAF SWITCH CIRCUIT (PW1852)

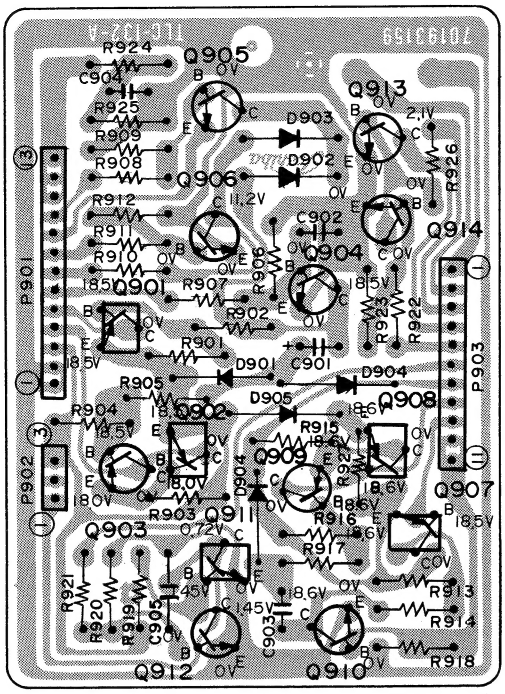


P661

1	P606 – 8
2	P606 – 4
3	P606 – 3
4	P831 – 2
5	S651



WIRING DIAGRAM OF PAUSE CIRCUIT (PW2113)



P903

1	P606 - 9
2	P606 - 10
3	P608 - 12
4	P981 - 3
5	P606 - 7
6	P507 - 4
7	L641
8	P941 - 3
9	L651
10	P608 - 11
11	P821 - 3

P901

1	P983 - 1
2	P802 - 9
3	P806 - 4
4	P821 - 5
5	P941 - 6
6	PH01 - 9
7	P983 - 5
8	PH01 - 6
9	P012 - 8
10	P508 - 2
11	P983 - 2
12	P651
13	PH06 - 2

P902

1	CYLINDER
2	
3	CYLINDER

U901 PW 2113 PAUSE CIRCUIT BOARD